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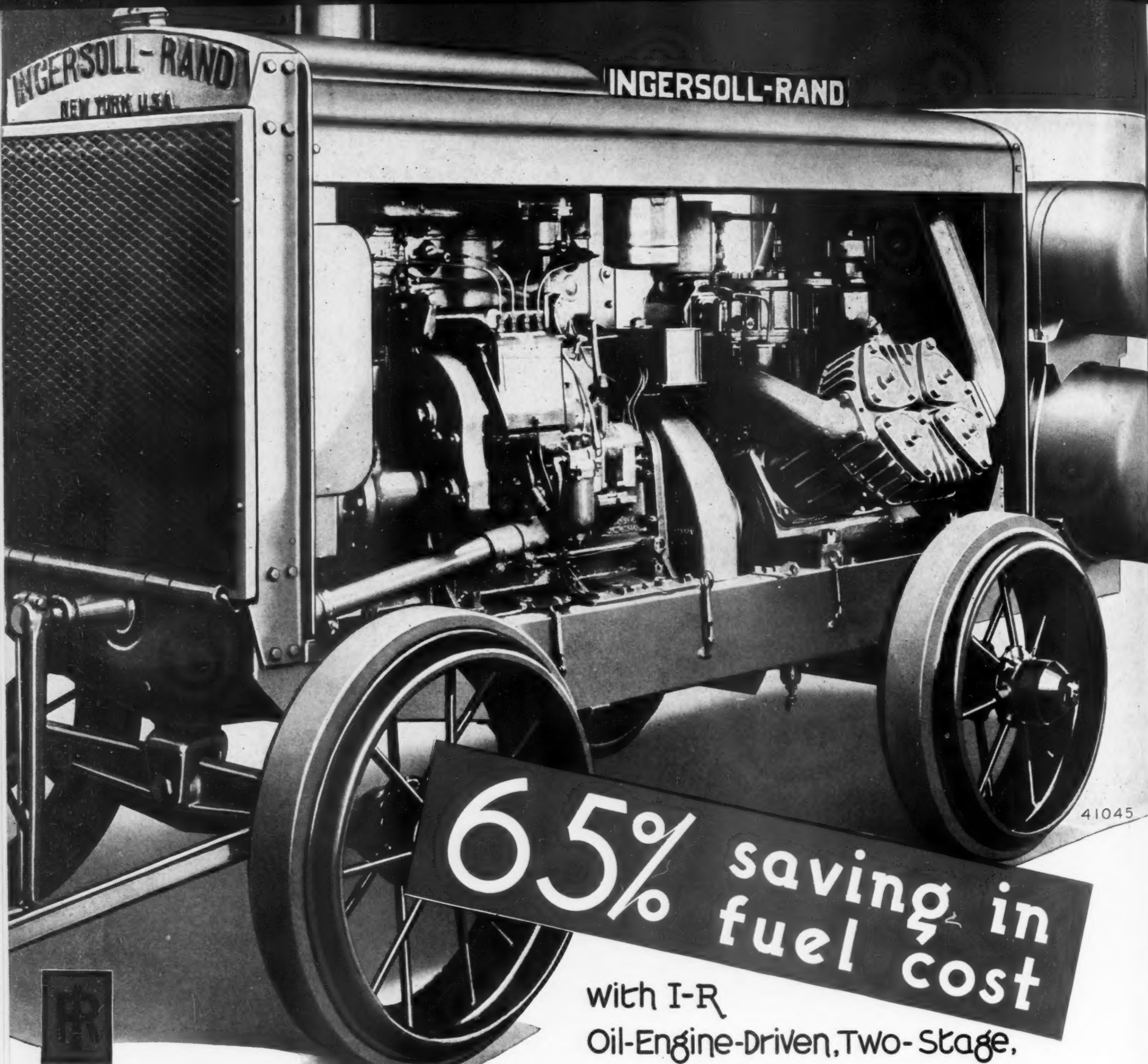
PHOTO BY R.T. JACKSON

COFFERDAM No.1, JOE WHEELER DAM, TVA.



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ADVERTISING INDEX

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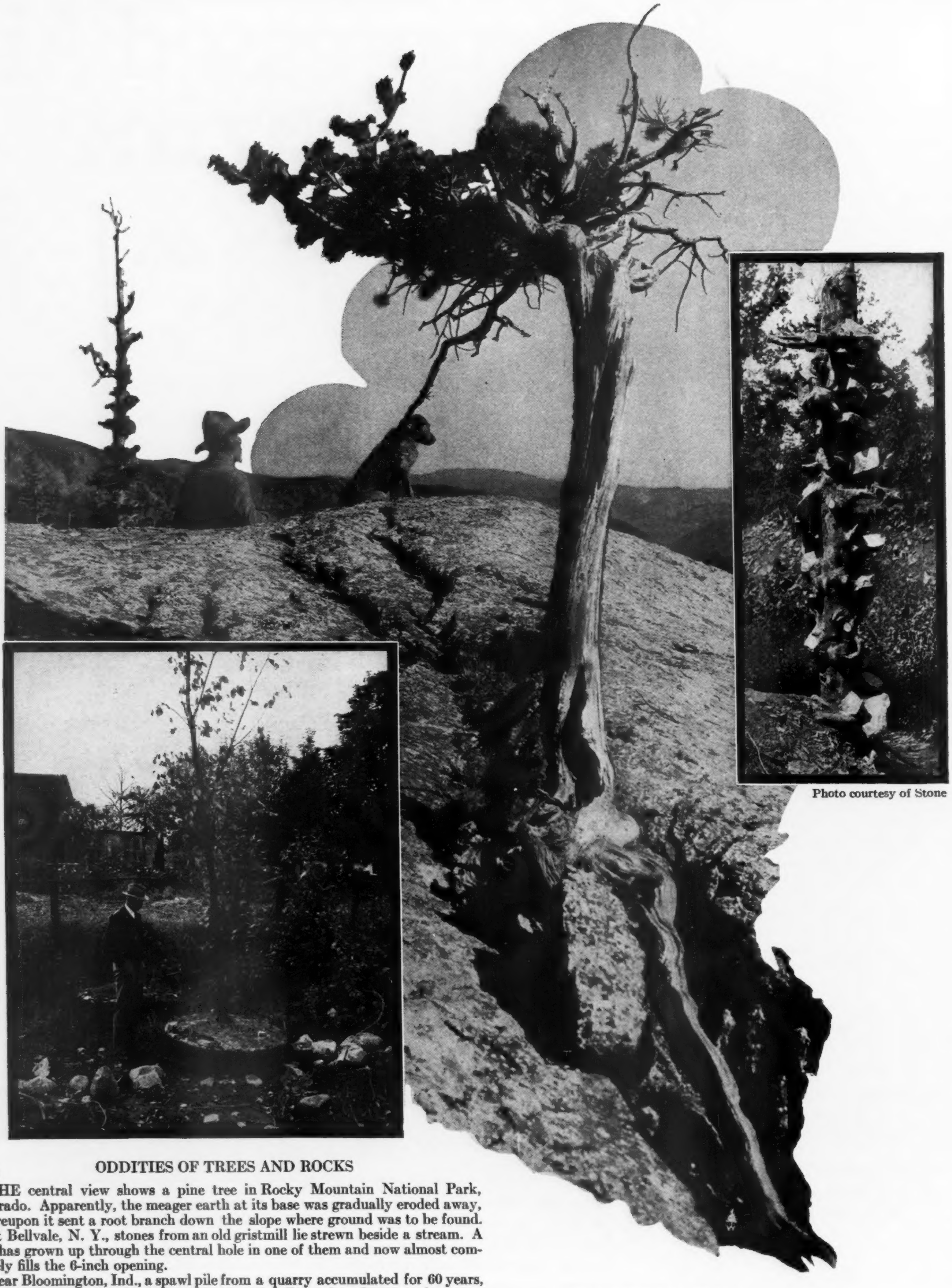


Photo courtesy of Stone

Colorado Association Photo.

ODDITIES OF TREES AND ROCKS

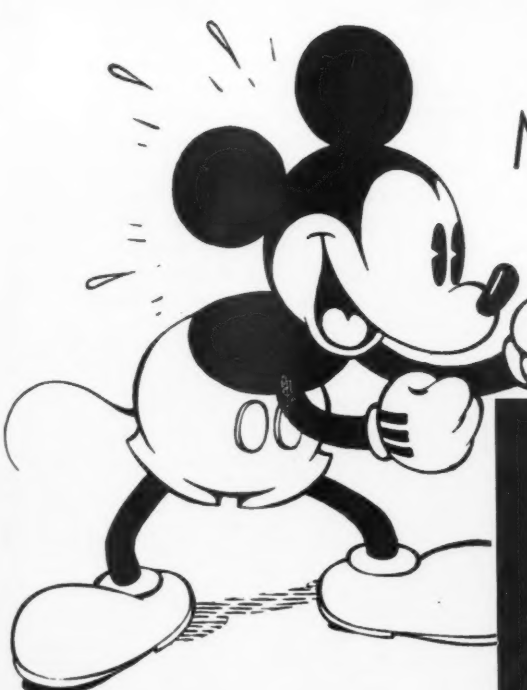
THE central view shows a pine tree in Rocky Mountain National Park, Colorado. Apparently, the meager earth at its base was gradually eroded away, whereupon it sent a root branch down the slope where ground was to be found.

At Bellvale, N. Y., stones from an old gristmill lie strewn beside a stream. A tree has grown up through the central hole in one of them and now almost completely fills the 6-inch opening.

Near Bloomington, Ind., a spawl pile from a quarry accumulated for 60 years, gradually surrounding the lower part of a tree. Recently, when a roadway was cut through the pile, rocks were found firmly embedded in the tree trunk.

The Saga of Michael Rodent

R. C. FLEMING



THE GREAT COMBAT

Mickey and Donald Duck square off for a fistic encounter. This drawing illustrates a scene from "Mickey's Orphan Benefit."

WHEN Mickey Mouse goes through some particularly funny adventure or antic with his ladylove Minnie Mouse, or a well-known fairy tale like the *Pied Piper of Hamelin* comes to life on the screen as a Silly Symphony, who has not wondered at the process by which these remarkable results are achieved? Who has not said, "How do they do it"? The Mickey Mouse pictures and Silly Symphonies are called animated cartoons; but, in beautiful Technicolor, with appropriate music matching the mood of the scenes, faithful in detail and natural in action, the pictures far transcend the usual meaning of the word cartoon and become art in a high sense.

The story behind these features is essentially the story of their producer, Walt Disney. Born in Chicago in 1901, Walt Disney became interested both in stagework and in cartooning while yet in grammar school. At McKinley High School, in Chicago, he did illustrations for the school paper and at the same time studied cartooning in the night school of the Chicago Academy of Fine Arts. He also bought a movie camera and projector and made movies of his own. In October of 1919 he returned from a year in France as an ambulance driver and chauffeur for Red Cross officials, and soon started to earn his living by drawing—first by illustrating advertisements for farm journals and then by making animated advertising films for a company in Kansas City. While so engaged he improved the methods of animating the films, and then made a cartoon reel at home in his spare time. This was sold for exhibition in three of the largest theaters in the city. After this experience he began to work on an idea for animating the old fairy tales in films of 500 to 600 feet in length.

He enlarged his home studio and got some young, prospective cartoonists to help him in return for instructions and promises of jobs if the first picture was a success. He worked at it in his spare time and used the salary from his regular position to finance the project. It took him six months to turn out the first picture, which was *Red Riding Hood*. He quit his job and formed a company to produce a series of these modernized fairy tales; but after the film was sold the distributing company went broke and Disney's company went into bankruptcy waiting for its money.

PHOTOGRAPHING A CARTOON

It requires about 11,500 separate exposures or frames to make up an 8-minute film, and each one of these must be photographed separately. The background, which may be the same for a number of scenes, is on paper and is held in position by pegs inserted through holes at the top of the sheet. Each figure shown is on an individual piece of celluloid. These are superimposed on the background and held in register by pegs at the bottom. A glass plate keeps the several thicknesses flat while they are photographed from overhead. The camera is moved up or down as desired by means of a mechanism actuated by compressed air.

There was nothing more to do in Kansas City, so, in August of 1923, he went to Hollywood, leaving behind him a pile of debts which took several years to clear up. He had a print of his latest picture with him, and with that as a sample he eventually landed a job with an independent distributor to make a series of pictures. For four years he produced a series of Alice cartoons for the Winkler organization, and then created and made a series of Oswald the Rabbit. This was quite successful, but Disney split with the company which continued to make Oswald the Rabbit while he started off again on his own.

He had to create a new character. Dogs, cats, rabbits, and other animals had all been featured in cartoons, and it was quite a problem to find an appealing character that had not been used. He soon settled on the idea of a mouse; and after some experimentation and consultation with friends the name Mickey Mouse was chosen for his character. The name Mortimer Mouse was considered, but was finally rejected as not sounding quite right. The first Mickey Mouse was made in the garage of Walt Disney's home by himself and his brother Roy, with some associates, while they were completing their contract to furnish Oswald cartoons for Winkler. This first picture was disappointing, but it was sent to New York to find a market while they finished up their Oswald contract and made a second Mickey Mouse.

In the meantime sound had come to the picture business, and it was soon evident to

the Disneys that they would have to add sound to their new series in order to sell them. Their third picture was started to be accompanied with sound. It was called Steamboat Willie and eventually was the first one of a series released under that name. It was finished in August, 1928. At that time it was impossible to have the sound synchronized with the film in Hollywood, so Disney took the film to New York and there, after much search, he found someone willing to synchronize in the sound at a price he could afford to pay.

The first recording was not satisfactory, as the musicians tried to apply the same methods they had already used with sound films—that of playing in time as they watched the film run off. The cartoon moved so much faster than an ordinary drama that they could not follow it with the score. They then tried a system Disney had planned for his work, and the synchronization was made successfully. This method was similar to the one which has been used since and is now practiced. As for the voices, Walt Disney, himself, has always taken the part of Mickey Mouse, and a permanent staff of voices has been built up for his other characters.

Steamboat Willie made a hit, and Disney went back to Hollywood with an idea for a new series which had been developing in his mind for months. This was the Silly Symphonies; and the plan was to have two series, Mickey Mouse and Silly Symphonies, in order to enlarge the market and to enable them to run in competitive theaters. Against a lot of advice to the contrary, he decided that the new series was not to have a principal character like Mickey Mouse and others around which the action should center, but was to be built entirely about a musical theme. The first Silly Symphony was based on the theme of *Danse Macabre*, although that music was not used. It was called The Skeleton Dance, and was made in the Hollywood studio with Mickey Mouse films.

In February, 1929, Disney took this Silly Symphony and the latest Mickey Mouse, The Opry House, to New York for sound recording. The Opry House was a success, but exhibitors thought the theme of The Skeleton Dance too gruesome; and only after much selling effort was a try-out finally given it at the Carthay Circle Theater in Los Angeles. There it had a great reception; and months later, after it had made a similar hit at the Roxy Theater in New York, it started on a highly successful run all over the country. This was the start of the Silly Symphonies.

Since that time the growth of the Disney Studio has been continuous. Just before sound came into use the studio produced 26 pictures for Universal with a staff of 22 people: now 175 people are employed in producing the same number of Mickey Mouse and Silly Symphony cartoons a year. Walt Disney says: "The artistic development of the cartoons, in my estimation, is remarkable. We make our characters go through emotions which a few years ago would have seemed impossible to secure with a cartoon character. Their facial expressions and actions are worked out very carefully to be certain that they will not be overdone to the point of appearing silly. There is kept just enough exaggeration to take them out of the real and into the imaginary, yet it must all appear natural to be effective. It has been said that some of the action produced in the cartoon of today is more graceful than anything possible for a human to do."

A modern studio has been constructed, representing a cost of more than $150,000, complete with an administration staff and all technical facilities, including recording and projection equipment, orchestras and appropriate voices, and a large staff of artists and animators. Artists must be trained for the type of work required; and to develop new talent the studio runs an art school where apprentices

A COURSE IN PENGUINOLOGY

Whenever unusual birds, animals, or insects are to be drawn, specimens are made available to the artists for study. This group of penguins (below) was imported from the Galapagos Islands and kept in the studio for several weeks while the animators became familiar with their antics. Their counterparts will appear in "The Peculiar Penguins," a film scheduled for release this year. Walt Disney is at the upper right.

THREE WELL-KNOWN THESPIANS

Horace Horsecollar, Clarabelle Cow, and The Goof, as the animator visualizes them. They are assisting actors in Mickey's troupe.

GETTING THE CORRECT EXPRESSION

If the animator wants Mickey to register a certain emotion, he simulates it himself and studies his features in a hand mirror. Note that the drawing is registered in position by pegs at the bottom. This drawing is made on paper and later traced on celluloid preparatory to being photographed. Several preliminary sketches are visible.

with good qualifications as draftsmen are trained for the work of animation. In this studio, cartoon technique has been improved so as to make the product steady and flickerless and to aid the animator in getting good and smooth action. Walt Disney holds patents on parts of the process which he has invented; but, without a doubt, most of the success of his work is due to his originality and to the careful attention given to the almost infinite details involved in making a picture of the high standard he has set.

A modern film moves through the projectors at the rate of 24 pictures, or frames, per second, or 1,440 per minute. The cartoons are made in one reel to run about eight minutes, so each production calls for 10,000 to 15,000 individual drawings. It is not possible to rehearse the actors as in the usual drama: the director must plan his entire production, with all entrances and exits, with all action plotted out, and have the scenes completely organized and edited before a single picture can be drawn. It is not always feasible to cut out even an entire scene when the film is completed because the continuity of the musical accompaniment might be lost.

The first step, and a most important and vexing one , in making a Silly Symphony is the selection of a story. A large library is kept in the Story Department, and the ideas may be obtained from fairy tales or folk lore or may be original with the studio staff, or they may be conceived as take-offs on current successful feature pictures. A rough draft of the story is prepared by the Story Department, and a mimeographed copy is given to all animators at a "gag" meeting. When a fairy tale is selected, only the basic idea is used, and suitable original action and gag material are adapted to it. At a later conference, suggested gags and situations are discussed, and the Story Department makes the accepted material into a definite story outline or scenario. The director and musician, with a "layout man" who pencils rough sketches of the scenes to uphold the action, then get together and prepare the continuity, keeping in mind the contemplated movement of the characters. These original sketches are modified time after time until the best possible setting is arrived at, and become the bases for the final background scenes used in the picture. An important part of this collaboration is the selection for each scene of a musical tempo that will suit the action depicted, for the actual pictures and the musical accompaniment are produced separately, and the synchronization of the two parts depends on strict adherence to the tempo chosen.

The complete story is then put in detailed form on a layout sheet divided into terms of bars of music, and, of course, the tempo of the music establishes just how many pictures or frames will be used with each bar. When this is completed, the director has the whole picture laid out to the last frame of the many thousands that go to make up the film, and the musical score has been laid out in relation to the action so that the place for each note is known. From this is prepared a production schedule, split into scenes, giving the tempo of each scene, the number of frames and the artist assigned to each, and a description of the scene and the action taking place. This sheet also bears notations showing whether a scene is to be a close-up or a long shot, and so on. The exact positions of sound effects are noted on the sheet by the musician, as well as each syllable of a dialogue, if used. Many artists work on these scenes, and yet their

RECORDING THE MUSIC

After the pictures are filmed, the sound effects must be synchronized with them. To do this, each artist wears earphones attached to a tempo-producing mechanism which gives the guiding beats at predetermined intervals. Note the numerous devices for producing varied sound effects. At the left, with his hand on a dial, is the technician who controls the volume of sound. Much of the music, that for "Three Little Pigs" for example, is composed in the studio.

style must be so similar that no difference can be detected in the completed film. Some are more adept than others at depicting eyes, or smiles, or facial expressions, or some particular bit of action like that, and they will be assigned that kind of work almost exclusively.

When the animator is given his assignment he is informed of the relation of his sequence to the rest of the picture, the particular action or situation that is to be developed, and the preceding and succeeding actions. The animator deals only with the moving figures: a background, based on the original scene-sketches, is supplied him from a separate department as his stage setting. He works on a field about 7x9 inches in size. It is now his function to show the action and to convey the ideas of the scene in the exact number of progressive drawings allotted to it. Sometimes it is necessary to change the number of drawings in order to express the idea effectively and naturally; but, when that is done, the musical score must be changed to suit. This is apt to be troublesome, and is avoided as much as possible.

A light-weight, hard-finish paper is used. To control its position on the drawing board and under the camera, the paper is perforated on one edge, outside of the camera field, with two holes which fit over pegs on the board and under the camera so that the pictures are always in a fixed position in regard to the optical center of the camera. The backgrounds, too, are held by two other pins to keep them in a fixed position in relation to the figures. The animator then makes his series of drawings, numbering them serially in the order in which they are to be photographed.

Each animator has an assistant and two apprentices to conserve his time, and he makes drawings only of the start, end, and extremes of each action while the assistants prepare the intervening drawings and supply the details. The drawings are made on top of a glass plate under which a strong electric light is placed; and immobile parts of figures are traced from preceding drawings. For instance, suppose a figure is raising an arm while standing still, and four frames are allotted to the action. The figure will be drawn once in the first posture, and then will be traced three times, altering only the position of the arm. In order to portray actions effectively, the animators study their own actions or expressions; and some of them have mirrors in front of them in which to watch their expressions while going through the actions or emotions desired. Studio employees can usually tell what animator has done a particular scene, because the figures ape the mannerisms of their creators who oftentimes get faint traces of their own expressions in their work. When unusual animals, birds, or insects are portrayed, like penguins or bees, living models are made available for study so that the artists can make the actions of their counterparts on the screen as realistic as possible.

These first simple pen-and-ink figures, without background, are photographed in order, and a test run is made to see if the desired result has been obtained. If the action is not so smooth and satisfactory as the standard of the studio demands, the series may be completely redrawn as many as four or five times until the best possible result is achieved. This is a large part of the studio's control and assures the natural action which is so evident in the cartoons.

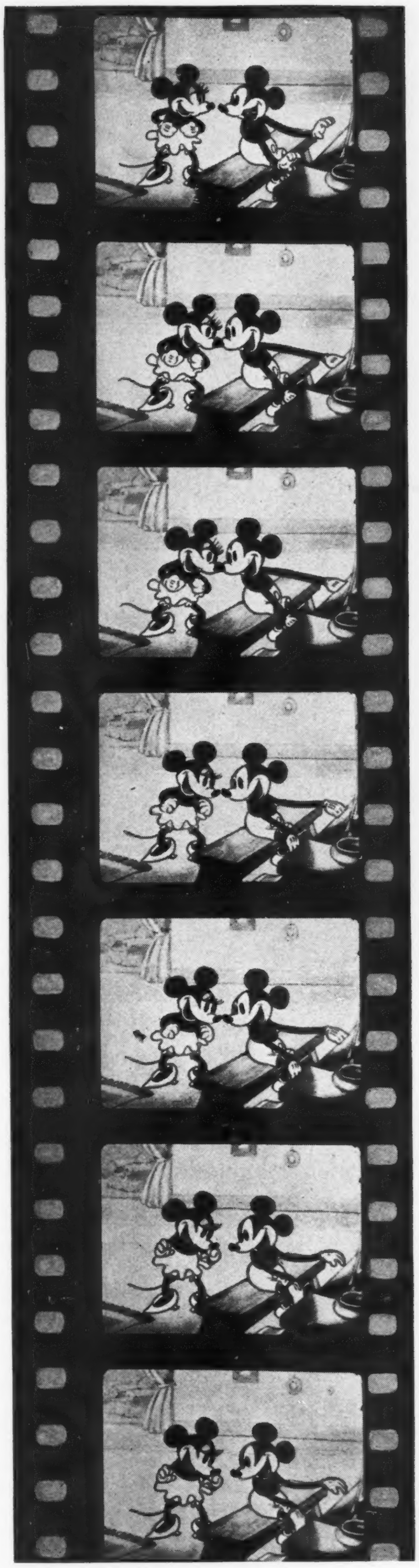
Each of the drawings of the accepted sequence is then traced on a transparent celluloid sheet by girls in the Inking and Paint-

ing Department, while on the reverse side of the celluloid the entire area occupied by the figure is made opaque by paint. If these transparents were not used it would be necessary to draw a complete background for each picture, which would make the production economically impossible. By this means only one background is needed for each scene; and when the transparent sheets are superimposed on the background, the opaque figures mat out the background under them and become an integral part of it. For each character in a scene, doing something different, is made a separate series of these celluloid sheets; and it is possible to have a large number of characters in each scene all going through their own actions. Practically, however, four sheets are the most that can be used, as the combined thickness of the celluloid affects the photographic quality of the picture. When less than four sheets are needed in any scene, blank celluloids are inserted in the make-up under the camera to maintain the photographic quality of the whole film.

The actual photography is a comparatively simple process. The camera is suspended vertically over the camera table and has a stop-motion mechanism to make only one exposure at a time. The background is on paper, and may be a strip 4 or 5 feet long if the figures move over it for some distance, as would a car or a figure running. In the filming of a scene like that, however, the figure is kept registered under the camera and it is the background that is moved a bit at a time, depending on the rapidity of the action, as each exposure is made.

For each frame the celluloid sheets are assembled over the background on the registering pegs of the board, and a glass plate is pressed down on them to keep the sheets tight together and to prevent curling. This glass plate is hinged, and is operated with compressed air by means of a foot treadle under the board. The air is supplied at 40 to 50 pounds pressure by an Ingersoll-Rand Type 15 compressor, an air-cooled, single-stage, and single-acting unit that is belt driven by an electric motor. The camera may be moved up or down for shots at varying distances, or may be rotated 360°. The up-and-down motion is controlled by an air cylinder supplied from the same source, and an air line is also available to blow dust off the table before an exposure is made. The board is lighted by two banks of lamps, one on each side. Each assembly in the sequence of drawings is photographed in this manner until the scene is complete.

Sometimes the action calls for shifting the camera from one part of the field to another, and then it is necessary for the animators to know with mathematical accuracy where the optical center for each shot will be. This is accomplished ingeniously by a celluloid sheet marked with ordinates and abscissas closely spaced and numbered each way. This sheet can be placed on the registering pegs, and the position of the camera for each exposure thus given in terms of ordinate and abscissa numbers. The smallest practicable field that can be photographed measures 1½x2 inches,



STRIP OF FILM

The film is of the same width as was used for silent pictures. In order to provide additional space at the left side for registering sound, the size of each exposure was reduced, and this adjustment increased the interval between frames. The film is one inch narrower than it is shown here.

and it may be located any place in the available field.

The action, the music, and the dialogue are recorded separately, and the synchronization of the whole, when combined, depends on the tempo selected for each part of the picture. Certain basic tempos, multiples of the frame speed of the film, are determined. The fastest tempo is one beat every six frames, amounting to four beats per second, and the slowest is one beat every twenty frames, or every five-sixth second. A machine, developed in the studio, establishes and maintains these standard beats. A vacuum-tube oscillator is employed to set up a constant sound, and the desired beat is maintained by a mechanical interrupter in the circuit. The interrupter is a small synchronous motor running a set of gear wheels on one shaft at constant speed through intermediate gearing. At certain points on the periphery of each gear wheel are riveted brass points so that, when the wheel revolves, each point will make contact in turn with a brass strip, thus completing a circuit and giving one beat in the earphones attached to the oscillator. A separate gear wheel with the contact points correctly spaced is provided for each tempo so that, by pressing one of a series of buttons, beats of a standard tempo are produced.

When music is recorded, each musician uses an earphone plugged into this circuit which sets the tempo that he is to follow. The conductor and the musicians know to the exact beat what action is to take place and where sound effects and syllables of dialogue are to be introduced. In order to enable the film cutter to determine with accuracy where the score begins, acoustical beats are recorded on the sound track at the beginning and end of a "take." A predetermined number of beats are reproduced, and then a time interval of silence precedes the first bar of music. By inspection of the sound track on the film, the cutter can find the exact beat on which the sound starts.

The color reproduction of these films is not done in the Disney Studios but in the studio of the Technicolor Process. The drawings are prepared in the usual way and colored in the Inking and Painting Department with any desired shades, only the final reproduction being made by Technicolor.

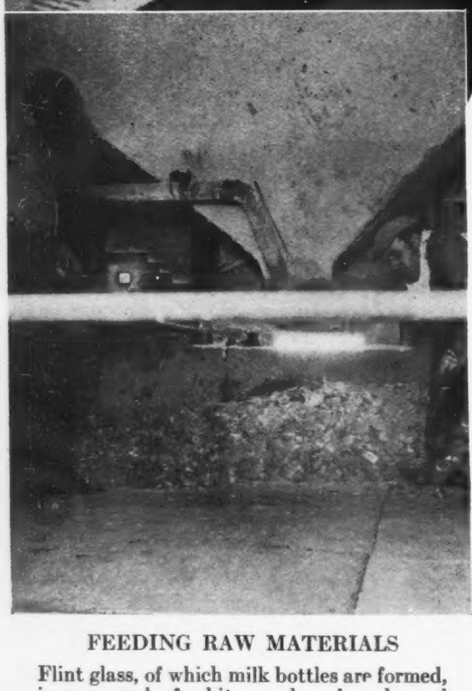
Silly Symphony and Mickey Mouse pictures made in this way have delighted millions of people, both children and adults, all over the world. Mickey Mouse, the Three Little Pigs, and their companion entertainers are liked by all classes of people. The catchy little song of the Three Little Pigs has been a vogue on radio and stage. Incidentally, that phenomenal success, the Three Little Pigs, may gross $150,000, which is a large sum for a cartoon but much less, of course, than many feature-film dramas make. The net profits from this picture, though, are not expected to exceed $25,000 from all world markets in two years. Such a picture may cost $20,000 to produce, or $2,500 for each minute of running time. But it is quite within the range of possibility that full length feature cartoons may some day be made.

Making Milk Bottles for the Multitude

R. G. SKERRETT

COMING FROM THE LEHR

The annealing of the bottles requires from two to three hours, depending upon their size. They are shown here emerging from the 90-foot heat chamber in which they are gradually cooled from an initial temperature of 1,100°F. The lehr is fired with fuel oil which is atomized with compressed air. Conveyors which move the bottles here and when they come from the forming machines consist of transversely arranged bars which revolve at a speed designed to produce the desired rate of travel.



FEEDING RAW MATERIALS

Flint glass, of which milk bottles are formed, is composed of white sand, soda ash, and lime, together with a certain amount of cullet or scrap glass. This view shows the rear end of a melting tank. The ingredients other than cullet are contained in the hopper overhead and are fed into the furnace by manual control. The cullet is shoveled into the opening.

COULD the Ancient Mariner of Coleridge visit the Long Island City plant of the Thatcher Manufacturing Company he would probably alter the poet's original phrasing to run:

"Bottles, bottles, everywhere,
Nor any drop to drink!"

In the storehouse of this establishment, on every hand, are tiers and tiers of crates piled high and filled with bottles of divers kinds that are kept continually in readiness to meet the changing demands of the market. By far the greater number of these containers are milk bottles, the making of which has been the plant's principal business for some years.

It is probably not generally known, but the average annual output of milk bottles during the last eight years has totaled 2,253,177 gross—which means a matter of 324,457,488 individual bottles. Those bottles have had a yearly value of close to $11,000,000. Manifestly, their manufacture is both a sizable and an important part of the activities of America's glass industry as a whole. The consumption of these containers is on the increase, and this has been particularly so latterly because of restrictions that have been placed upon the sale of loose milk. This prohibition has been inspired by the health authorities of several of our states. According to the most recent statistics issued by the Bureau of the Census, there are 21 establishments in the United States that are mainly or entirely engaged in the production of milk bottles.

For reasons that will be readily understood, milk bottles are commonly manufactured in or near the section within which they are to be used. This reduces transportation charges and the number of handlings between the glass plant and the consumer. It was because of these considerations that the original owners of the plant, the Peerless Glass Company, decided to locate in Long Island City; and in the course of the succeeding years that factory gradually extended its business until it was making bottles for customers throughout much of the whole metropolitan zone. The Thatcher Manufacturing Company purchased the plant last year. The new owners, who have their headquarters in Elmira, N. Y., have specialized for a good while in the production of superior-quality milk bottles, among other excellent glass containers; and to avoid confusion we shall confine our description in this instance to that of milk bottles as they are turned out in Long Island City. The procedure followed and the equipment in use there give an excellent idea of the plant as a

INSPECTING AND PACKING

After leaving the lehr, the bottles continue on the conveyor to a station where they are sorted according to the names cast into them and packed for delivery to customers. To make sure that specified standards are maintained, one is periodically selected at random and subjected to three tests. They must prove capable of withstanding a temperature range of 90 degrees and a hydrostatic pressure of 300 pounds to the square inch, and pass a polariscope examination as to the uniformity of annealing.

whole and of the high standard of its output.

A glass plant of any sort is always an interesting one and often spectacular in places; and to the average person it is a source of wonderment how the raw materials used are transformed into an incandescent molten bath and then modeled rapidly into bottles by machines that function as if inspired by a will to do. Again, after the bottles are automatically blown, they are marched from the blowing machine in a steady procession by ingenious mechanisms that deliver them to nearby lehrs or annealing furnaces where they are made finally fit to meet some of the exacting conditions of every-day service. As is commonly known, the average milk bottle is refrigerated to keep its contents fresh, and, in turn, it is washed in hot water to cleanse it and to sterilize it. These extremes of temperature would cause an unannealed bottle to fracture suddenly. Furthermore, because of the decidedly rough handling to which milk bottles are subjected, they must be rugged.

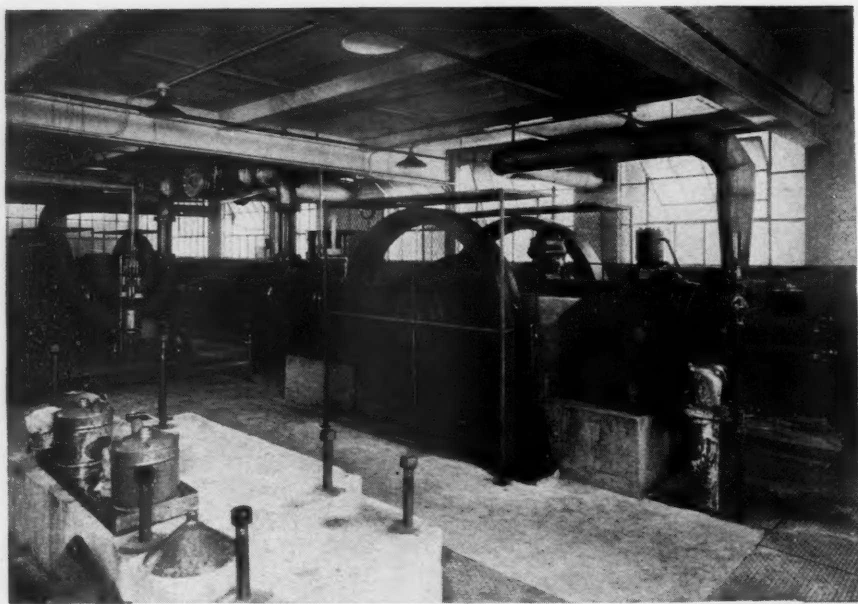
Milk bottles usually are made of flint glass; and glass of that kind is the product of three raw materials—white sand, soda ash, and lime, to which is added a proportion of cullet. Cullet is the trade term for broken glass, and in this case the cullet is supplied by the fractured or imperfect ware produced in the plant and which inevitably accumulates during the course of bottle manufacture. The principal basic material is the white sand; and because that sand is somewhat refractory, the soda ash is added to the mix as a flux to induce melting. The lime acts both as a clarifier and as a hardener. Cullet serves a twofold purpose: It is economical thus to dispose of a by-product that is already refined, and, next, in the tank furnace the cullet helps to combine all the raw ingredients and to promote the general fusing of the entire batch. Cullet, so it is said, also helps to purge the bath of gas bubbles and to quiet the fluid mass so that it will be in a prime condition for feeding to the bottle-blowing machines.

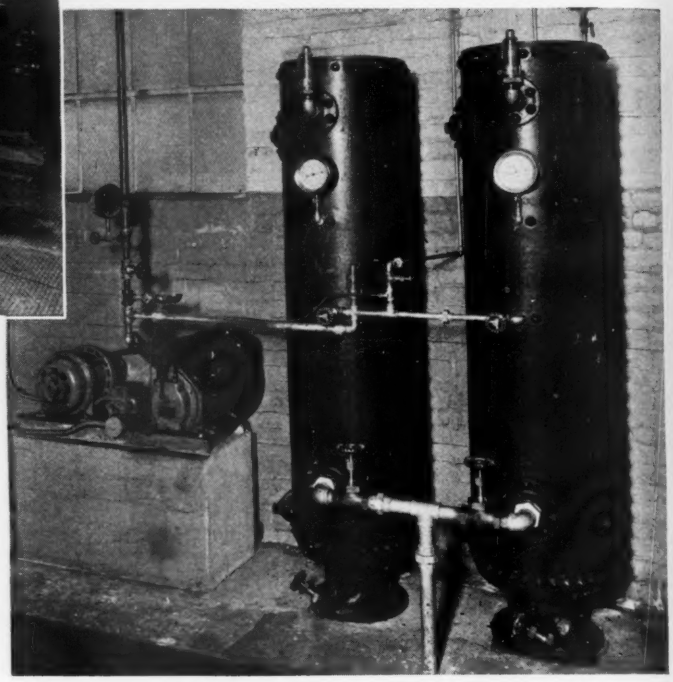
At the Long Island City plant there are two tank furnaces in which glass is made ready for blowing. They are of the continuous tank type, that is, they both melt and refine the glass continuously. One has an output of 50 tons of molten glass in 24 hours, while the other has a capacity of 60 tons in the same period. Each furnace is of the regenerative type and uses heavy oil for fuel. The oil is fed to the burners at a hydrostatic pressure of from 200 to 300 pounds, and is atomized at the burners with compressed air at a pressure of 50 pounds per square inch. The mixture of raw ingredients is fed into each tank furnace at one end and the refined glass is drawn off at the other, where there is a forehearth into which the molten glass flows. From the forehearth, the glass is delivered to a mechanical feeder that automatically and uniformly supplies the exact amount of glass to each mold of the blowing machines. The three raw materials—sand, lime, and soda ash—are placed mixed upon a conveyor that discharges into a hopper, at the rear end of the furnace, from which the batch is fed by hand control to the receiving end of the furnace.

When starting cold, it takes fifteen days of heating to get a tank furnace ready to deliver glass for working; and for that reason furnaces of this type are run continuously for from eight to ten months before they are shut down for overhauling. The operating temperature is 2,600° F., and this intense heat is progressively destructive to the refractory blocks that are used to line the furnace. The 50-ton unit supplies glass to three automatic blowing machines, and the 60-ton furnace provides glass for four such machines. Bottle-making is carried on uninterruptedly night and day for six days of each working week.

The bottle-blowing machines are of the air-driven type, and are the product of the Miller Machine & Mold Works, Columbus, Ohio. Compressed air both operates the machines and also blows the bottles. The driving air is at a pressure ranging from 25 pounds to 30 pounds, and the pressing and blowing of the bottles are done with air at a pressure of 30 pounds to 45 pounds. The air consumption is equivalent to 80 cfm.

Each machine is equipped with a single rotating table that is operated with an intermittent motion—that is, the table pauses momentarily during the successive filling, pressing, transferring, blowing, and discharging of the molds, of which there are eight. The molds are of two kinds: 1-piece and 2-piece molds. The latter are hinged vertically so that they can open to receive the bottle "blank" and to discharge the finish-blown bottle. The split molds are engraved so as to impress upon the glass the names and symbols of the differ-





SOURCE OF AIR SUPPLY

These two oil-engine-driven compressors (above), each consisting of a 105-hp. engine direct connected to a single-stage compressing cylinder, supply air for blowing the bottles, effecting movements of the machines, atomizing oil, and for other purposes. Designed to utilize an inexpensive fuel, they operate with great economy. High-pressure starting air for these compressors is furnished by the 3-hp., 2-stage, air-cooled unit (right) and stored in the two receivers. This small machine also supplies air for the dry-sprinkler fire-protection system with which the plant is equipped.

ent customers; and the bottles are made up in half-pint, pint, and quart sizes. The machines are entirely automatic; and there are five operations in the production of each bottle.

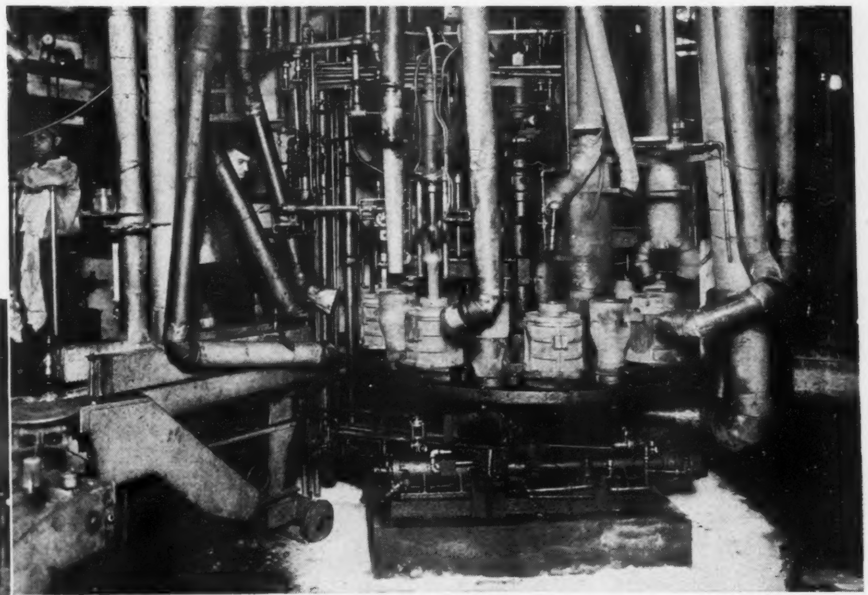
When an empty blank mold pauses directly beneath the air-operated automatic feed, a "gob" or solid bar of glowing glass issues from the nozzle of the feeder and is sheared off when of just the right length and volume to make a bottle of a prescribed size. The gob drops into the blank mold, which then swings to the next position where an air-operated blowhead presses down upon the upper end of the imprisoned ingot and forms the roll top and the cap seat of the evolving bottle. At the third halt, a pair of mechanical fingers or tongs grip the neck of the bottle blank and lift the blank from the first mold and transfer it to a blowing mold which has swung open to receive the tapered body of still glowing glass. This split mold next swings to a point directly below another blowhead which comes down on top of the mold, seals it, and discharges enough compressed air to enlarge the incipient cavity in the neck. This fourth operation converts the glass below the neck into a bubble that is expanded and forced downward and outward against the confining walls of the mold— thus producing and finishing the bottom and the body of the bottle. At its fifth stage, the completed bottle is picked up and removed the moment the mold opens for that purpose.

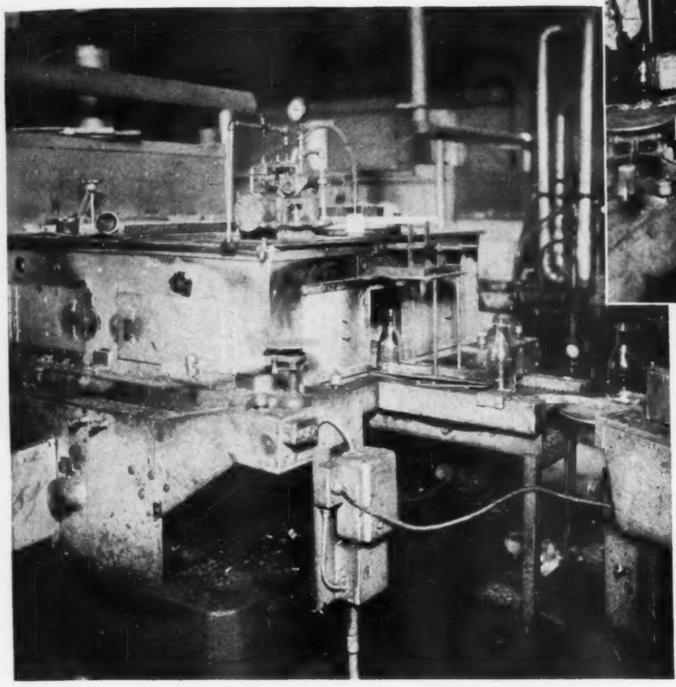
Each machine of the type described is equipped with a built-in wind system; and there is a special overhead wind-box for cooling the molds. Without this cooling system the molds would become too hot from contact with the highly heated glass and would not sufficiently solidify the glass to prevent deformation during the formative steps. It is equally important that the cooling be nicely regulated lest the pressing and blowing be imperfectly done.

Each machine in the plant is capable of making in the course of a minute sixteen quart bottles, or eighteen pint bottles, or 19½ half-pint bottles. Rapidly as a bottle can be produced, still success would not be assured if the glass fell short of the right consistency and if the temperature were not lowered at each step to the required point so that the glass would respond to the perfectly timed functioning of the machines. While each machine is fully automatic, yet an attendant is needed to maintain those conditions that are necessary to the production of good bottles. The attendant also removes any imperfect bottles; and at stated intervals places a bottle on a balance to see if the lot is running true to the prescribed weight. When issuing from the blow mold, the red-hot bottle must be rigid enough to stand up without change of form during its transfer to the nearby lehr into which it is conveyed for annealing.

The transfer from the machine to the lehr is effected by a short interposed conveyor of an ingenious order. The floor of the conveyor is composed of a series of closely spaced, parallel, transverse rods, all of which revolve at a uniform rate and move the bottles continually toward the receiving end of the lehr where an "usher," consisting of horizontal arms, guides the bottles into the lehr. As each succeeding bottle arrives at the entrance, the usher shifts to different positions to the right or the left and arranges the bottles on the conveyor in a succession of ranks. In the same way, like a column of soldiers marching in close order, the bottles subsequently issue from the far end of the lehr. This conveyor is of the same type but wider than the one that carries the bottles from the blowing machine. Each lehr is 90 feet long, and the period of travel through it varies from two to three hours, depending upon the size of the ware—the larger and heavier bottles requiring a longer annealing period than the smaller and lighter ones. The lehrs are of the Thermal Engineering Corporation type; they are oil fired; and each is equipped with thermocouple pyrometers that regulate the temperature. The initial temperature is 1,100°F., and this diminishes gradually toward the outlet end. The fuel oil is atomized with compressed air. A blower at the intake end maintains a gentle draft which circulates the hot air from end to end of the apparatus.

The bottles on issuing from the annealing lehrs are inspected and sorted according to their lettering, and are then packed into crates ready for delivery. However, nothing is taken for granted, and every now and then a bottle is removed from each lot and subjected to





WHERE BOTTLES ARE BORN

In this automatic, air-operated machine (above) "gobs" of glass are first formed into blanks and then blown into perfect bottles. The actual forming of the bottles takes place in the hinged molds. Such a mechanism can turn out sixteen quart bottles a minute, or larger quantities of smaller ones. As the bottles come from the machine, they are moved by a conveyor (left) into the lehr where they are annealed to remove internal strains so as to enable them to withstand the wide range of temperatures to which they will be subjected when in service.

three tests: a hydrostatic test, a hot-and-cold water test, and a polariscope test. There is a difference of 90 degrees between the extremes of the hot-and-cold test; and in the hydrostatic test the bottles must be able to withstand a bursting pressure of 200 pounds per square inch. The polariscope test serves to give a visual check on the annealing or tempering of the glass—the distribution of the coloring indicating the acceptability of the bottle. It should now be self-evident that much care is exercised in the making of the familiar milk bottle so that it may stand up under the somewhat rough-and-ready handling to which it is exposed during its varied range of service.

From the days when the Long Island City plant was called into being, down to the fall of 1932, the primary source of power in the establishment was steam. Latterly, the boilers that were coal-burning have been fired with fuel oil atomized with compressed air. The compressed air utilized in bottle-blowing, in the regenerative tank furnaces, in the lehrs, in the boilers, etc., was, prior to the date just mentioned, provided by three Ingersoll-Rand Type 10 steam-driven compressors—two of them having been purchased in 1914 and one of them considerably earlier. The oldest machine is an XPV type with an approximate capacity of 700 cfm. The two duplex compressors that were bought twenty years ago have a combined capacity of about 1,300 cfm. These machines have a stroke of 16 inches, steam cylinders of 22&16 inches, and air cylinders of 16&16 inches. They have an operating speed of 106 rpm.

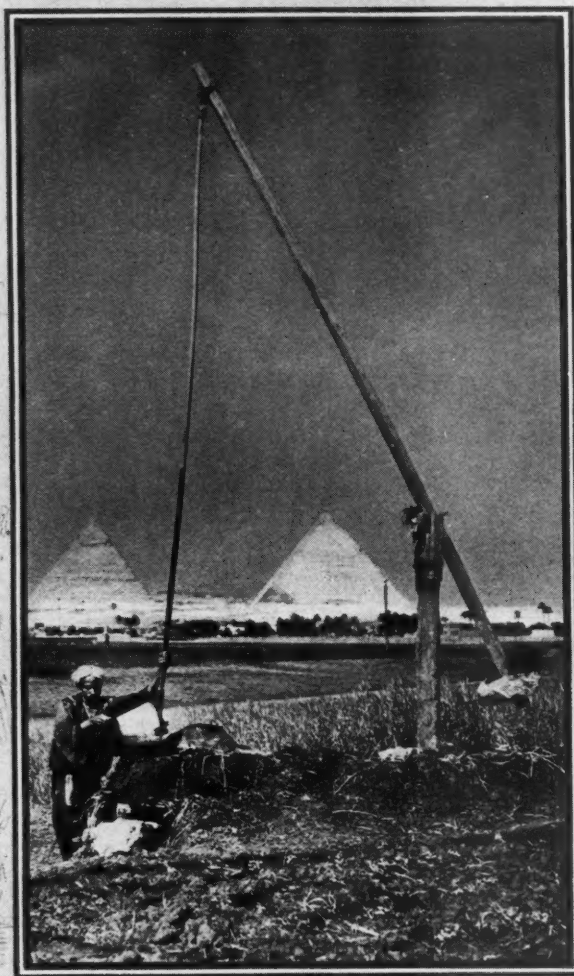
In the name of economy, and in response to a demand for increased efficiency, the plant was equipped in October of 1932 with two POC-1 Ingersoll-Rand compressors. Each of these new units is driven by an oil engine of 110 hp. — the engine cylinder being 17 x 19 inches and the associate air cylinder 15 x 19 inches. The latter has an actual free-air delivery of 695 cfm. when operating at a gauge discharge pressure of 50 pounds. When the plant is in full swing, both oil-engine compressors are in service. Each machine consumes an average of 6 gallons of fuel oil per hour. Mr. A. W. Crownover, superintendent of the plant, speaks highly of the units' performances, and is thoroughly satisfied with the way in which they have worked since their installation.

The oil-engine compressors are housed in a structure that was built especially for them and contains, in addition, auxiliary equipment in the form of one Type 30 Ingersoll-Rand compressor, driven by a 3-hp. electric motor, which supplies starting air for the POC-1 machines. The starting air is stored in two receivers; and some of it is utilized in the plant's dry-sprinkler system. The auxiliary compressor is 4&2½x2¾ inches in size, and by serving the twofold purpose has obviated the purchase of a separate compressor for the sprinkler system. The engine room also is provided with an Ingersoll-Rand Motorpump capable of delivering 50 gpm. to the oil-engine compressors for cooling purposes. The water is drawn from a nearby well, 16 feet deep, which was dug close to the East River shore and which is influenced by the rise and fall of the tide in that stream.

According to the engineer directly in charge of the oil-engine compressors, those machines have operated without any mechanical hitch during their service up to date; and recently one of them ran continuously, night and day, for six weeks, being stopped then only long enough to change the lubricating oil before starting up again. The practice in the plant is to change the lubricating-oil filter bags every five weeks; and it has been found economical to scrap the used bags. As the engineer expressed it: "The compressors run so sweetly we hardly know they are in service." The Motorpump, which supplies the circulating water, has cost only 40 cents for repairs since it was put in. The compressor plant is equipped with an American air filter and an Ingersoll-Rand silencer.

During shut-down periods for the overhauling of the tank furnaces, Ingersoll-Rand paving breakers are used to clear out any residual solidified glass—a practice that has become fairly widespread in different branches of the glass industry.

While we have limited our description to the making of milk bottles, still the plant does manufacture other wide-mouth ware as well as beverage bottles. To turn out different products, it is necessary only to fit the blowing machines with suitable molds and to adjust the cut-off of the automatic feed.



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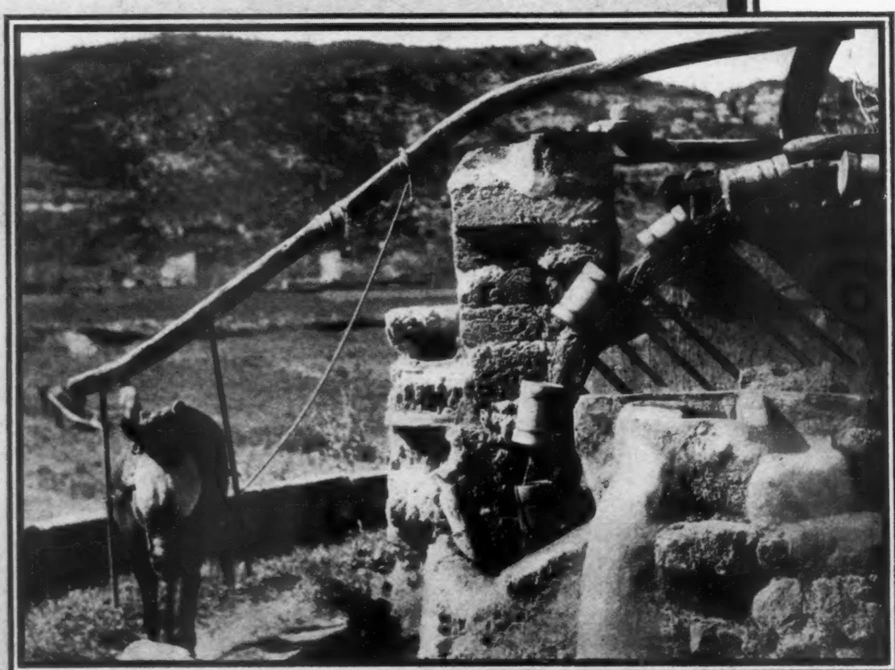

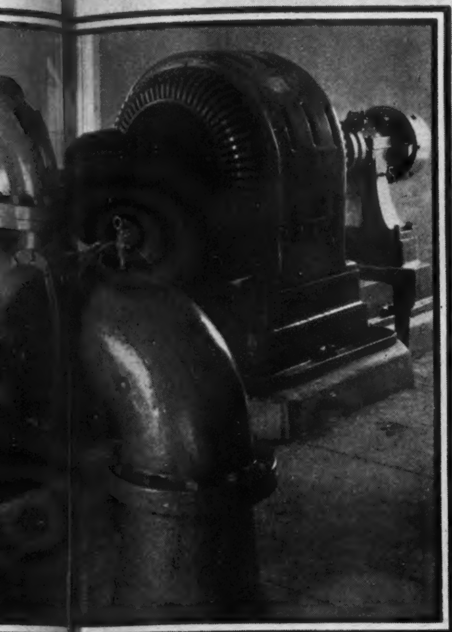

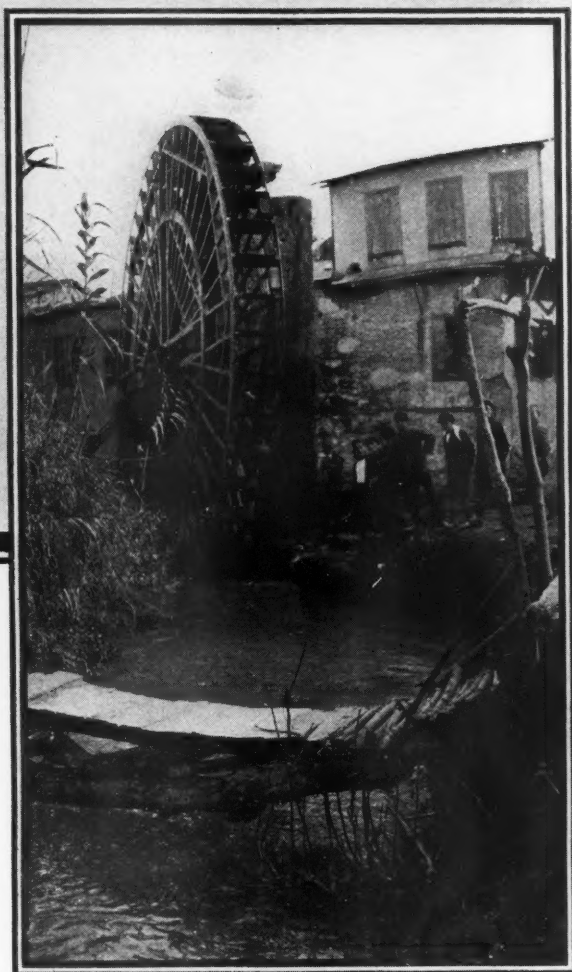

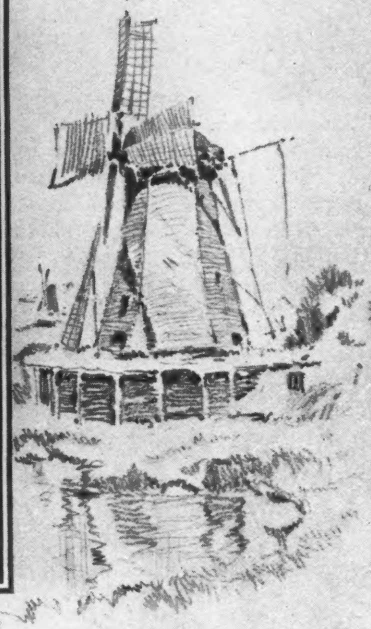

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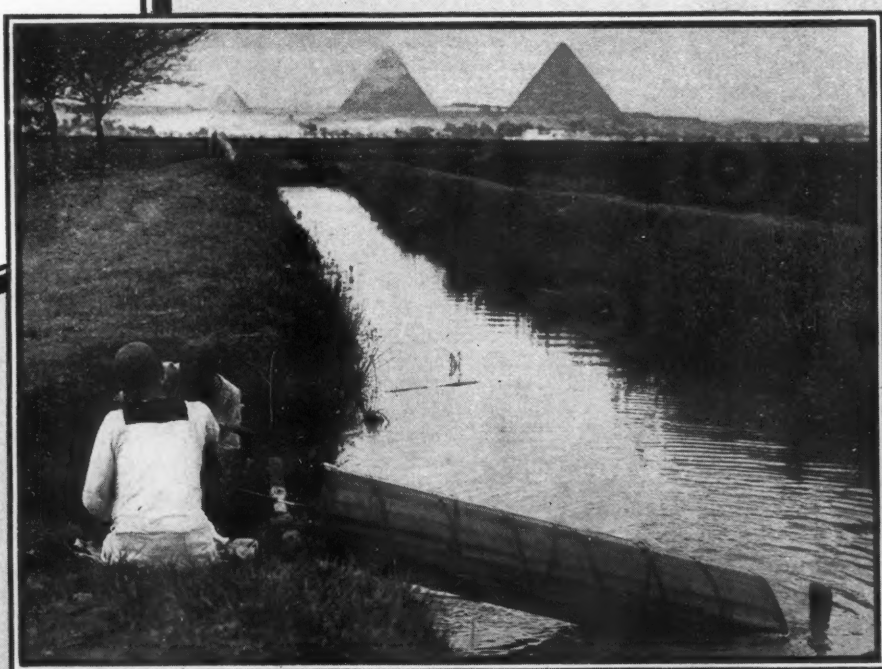
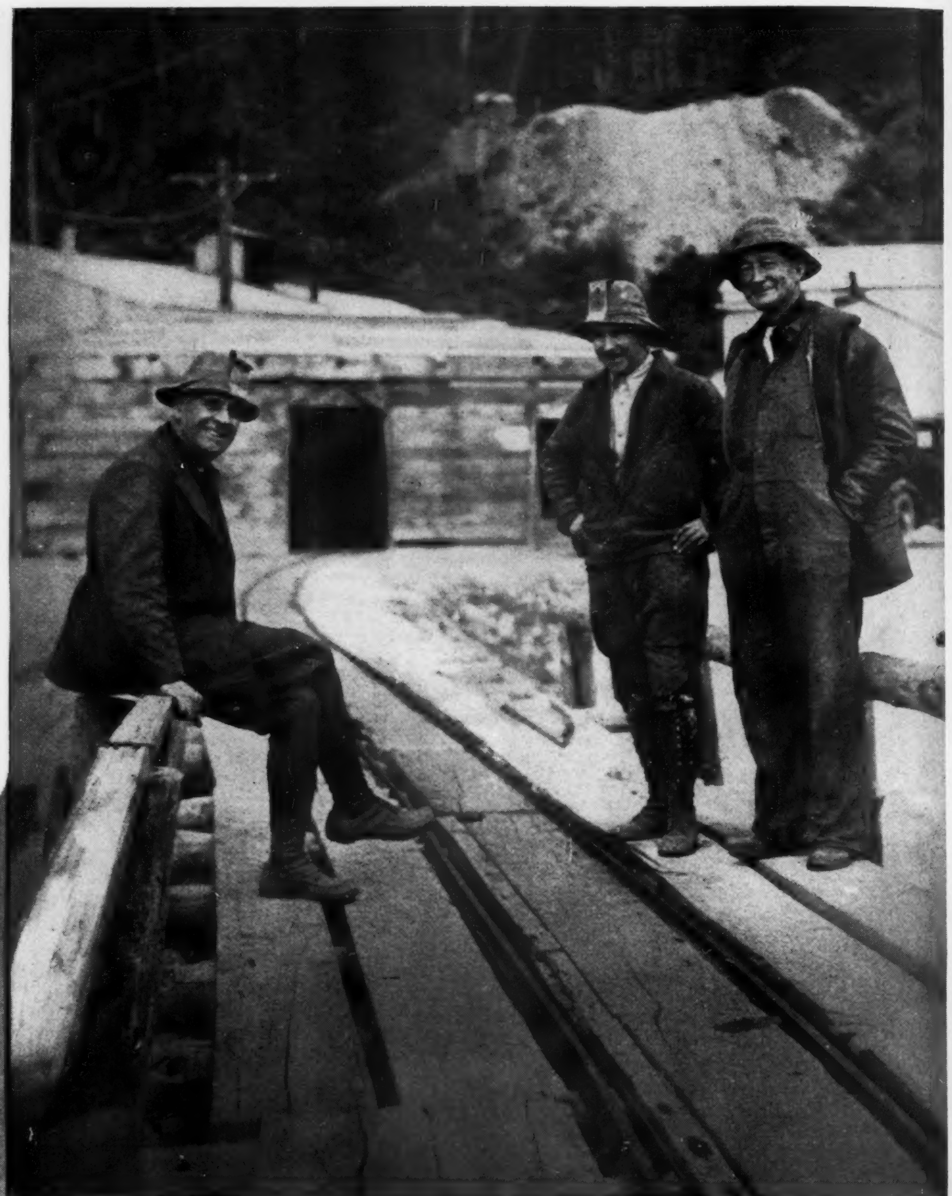


The Secretary of War Goes Back to the Mines

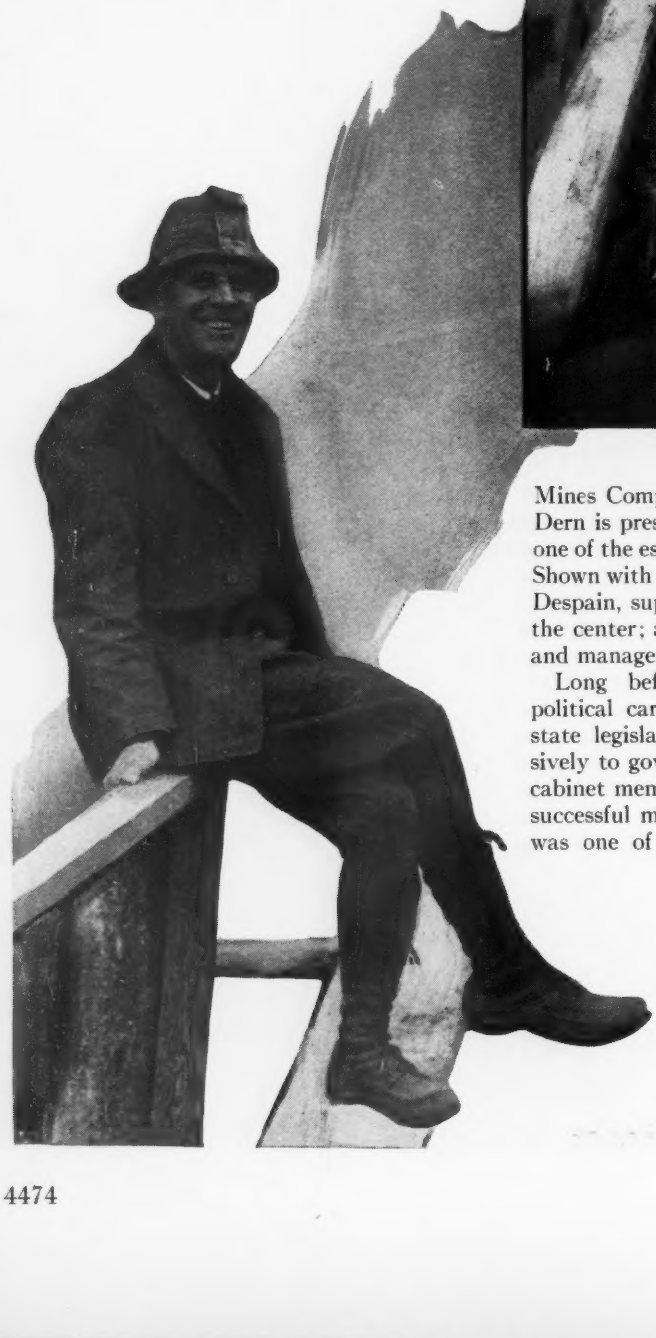


THE accompanying pictures show Secretary of War George H. Dern as he appeared last month when he spent ten days in Salt Lake City and vicinity visiting mining properties in which he is interested. When these photographs were taken he was resting for a moment on the bridge leading to the ore bins of the Park City Consolidated Mines Company at Park City, Utah. Mr. Dern is president of the company, which is one of the established producers of the West. Shown with him in one picture are: Douglass Despain, superintendent of the property, in the center; and J. J. Beeson, vice-president and manager.

Long before Mr. Dern launched his political career as a member of the Utah state legislature, and then climbed successively to governor of his home state and to cabinet member, he had won his spurs as a successful mining man. With his father he was one of the builders of the Camp of Mercur, Utah, which blossomed into a community of 2,500 souls, then faded into desert waste when the gold ores grew lean.

As a young mining engineer, fresh from Nebraska, Mr. Dern gained practical experience as treasurer of the Mercur Gold Mining & Milling Company from 1894 to 1900. For thirteen years thereafter he was general manager of the Consolidated Mercur Gold Mines Company. When large-scale operations were abandoned at Mercur he became president and general manager of the Mines Operating Company at Park City. From there he went to the Tintic Milling Company at Silver City as general manager. Meanwhile, he and Theodore P. Holt had developed the Holt-Dern ore roaster and formed a company for its exploitation.

Although he has been active in public life for a number of years, Mr. Dern has retained his mine holdings, and his interest in mining has never diminished. The smile that he wears in these pictures is ample evidence that he still enjoys getting into his digging clothes and going underground.

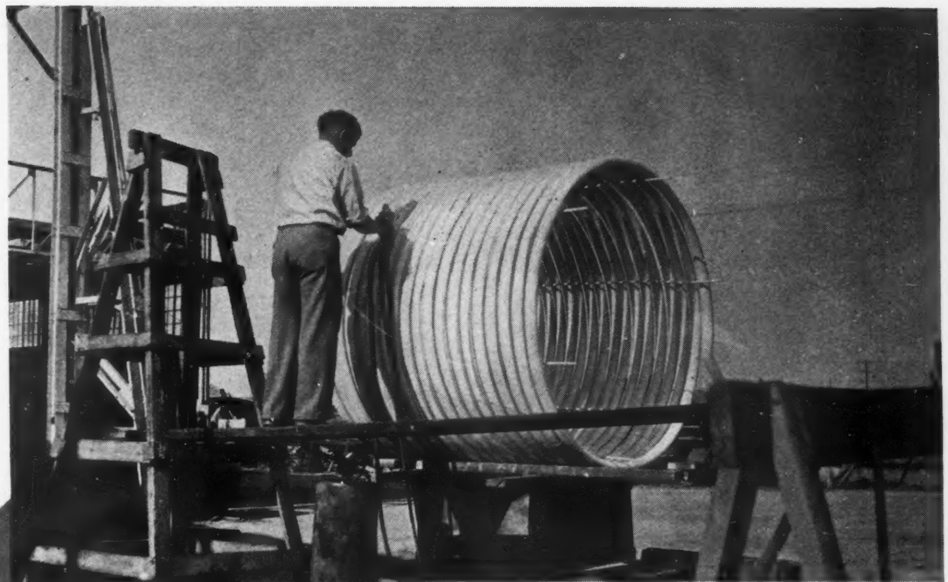


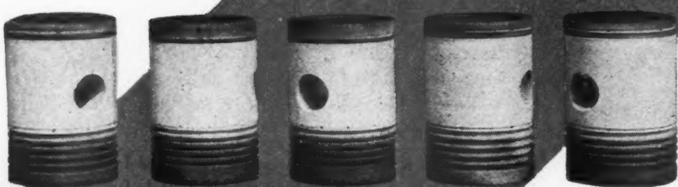
MR. DERN'S SMILE

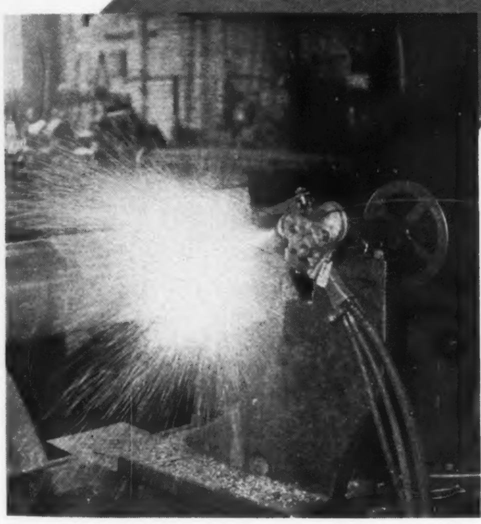
betokens the happiness he finds in donning his digging clothes during a brief respite from arduous official duties.

Spraying Metals with Compressed Air

C. H. VIVIAN







Photos, Metal Spray Co.

INCREASING SERVICEABILITY

These pictures illustrate typical work done recently on the Pacific Coast. A 7½-inch diesel-engine crankshaft which became worn at the bearing surfaces is shown at the lower left being treated. For a distance of 14 inches from either end it was first undercut ⅙ inch. High-carbon steel was then sprayed on the sections until they were .02 inch oversize, after which they were ground to correct size. The five 8½-inch-diameter pistons in the center were sprayed with cold-rolled steel on the groove and end sections and with duralumin on the center sections. One company reports that in the past three years it has in this way successfully built up 500 pistons. The tubing shown above was designed for handling vegetable oils and was sprayed with aluminum to prevent contamination and discoloration of the finished product.

THE spraying of molten metals with compressed air is not new. It was introduced in this country twenty years ago and has been described previously in this publication and elsewhere. Its greatest development, however, has come within the last five years, and has been particularly rapid during the past year. The process is now firmly established in the industrial field and has, in addition, won recognition in the arts through its capacity to produce numerous and varied attractive decorative effects. In view of these facts, a review of some of its accomplishments and of its promises of increasing service in the future should prove of interest.

Metal-spraying was first advanced as a means of making exposed surfaces more resistant to corrosion, and is still most used for this purpose. It is also widely employed for applying coatings in increasing heat and fire resistance, for adding dimension and weight to worn or faultily machined parts, for making materials electrically conductive, for making molds in reproducing shapes, for rendering objects more pleasing to the eye, etc.

In all cases, the method of treatment is fundamentally the same. It consists of melting a wire composed of the selected metal in an oxyacetylene flame, and then of atomizing it and blowing it upon the surface to be coated with a blast of compressed air. These essential operations all take place inside a compact, light-weight tool. For ordinary coating of large surfaces the apparatus is manipulated by hand, and its operation is generally similar to that of spraying paint or any other liquid with compressed air. Where rounded surfaces or numerous small objects are to be coated, the usual practice is to mount the tool in a suitable position and to move the objects, either by turning them in a lathe, by tumbling them in a barrel, or by any other method that answers the particular need.

A wide range of metals can be sprayed, and the process is being successfully used with virtually all those that are desirable for the purposes served and that are obtainable in wire form. Lead, zinc, and aluminum are most employed because they best meet the dual requirement of high resistance to corrosion and relatively low cost. In some instances, two or more metals are separately sprayed in successive layers. The base material may be almost anything. In industry it is generally metallic, but in the arts it is frequently wood, pottery, terra cotta, etc. Even thin paper can be sprayed without injury, and delicate laces are sometimes used as stencils to obtain decorative effects. Although the metal is extremely hot at the instant of spraying, it does not burn or scorch easily flammable substances because it cools almost instantly and because the spray is continually moved about over the area being coated. This is more readily understandable if one remembers that one's hand can be moved through a flame quickly without incurring a burn. By means of special extensions from standard spray mechanisms it is possible to coat the interiors of pipes and other recessed forms.

This process is the outgrowth of the unremitting search for means of checking or retarding corrosion. Rust and other forms of deterioration of structural materials produce wastage amounting to more than $300,000,000 annually in the United States alone, according to figures compiled by the Department of Commerce. It so happens that the ferrous metals, which are best adapted from the standpoints of strength and cost to serve the demands of construction and industry, are exceedingly vulnerable to corrosion. Recent metallurgical advances have made it possible

to produce alloys such as stainless steel which are highly resistant to corrosion, but their cost thus far is prohibitive for ordinary purposes. Paint, asphaltum, and various protective coatings have long been used to prevent moisture from reaching iron and steel surfaces and causing the formation of rust. More recently, electroplating and similar processes have provided means of accomplishing the same end, but limitations of cost and application preclude their use in many kinds of work. Metal-coating may be considered one of the long list of methods devised for fighting corrosion. Its field overlaps those of some of the other methods, but, by and large, it has a definite province and should not be classed as competitive with painting or with any of the others, all of which have more or less wide ranges of service.

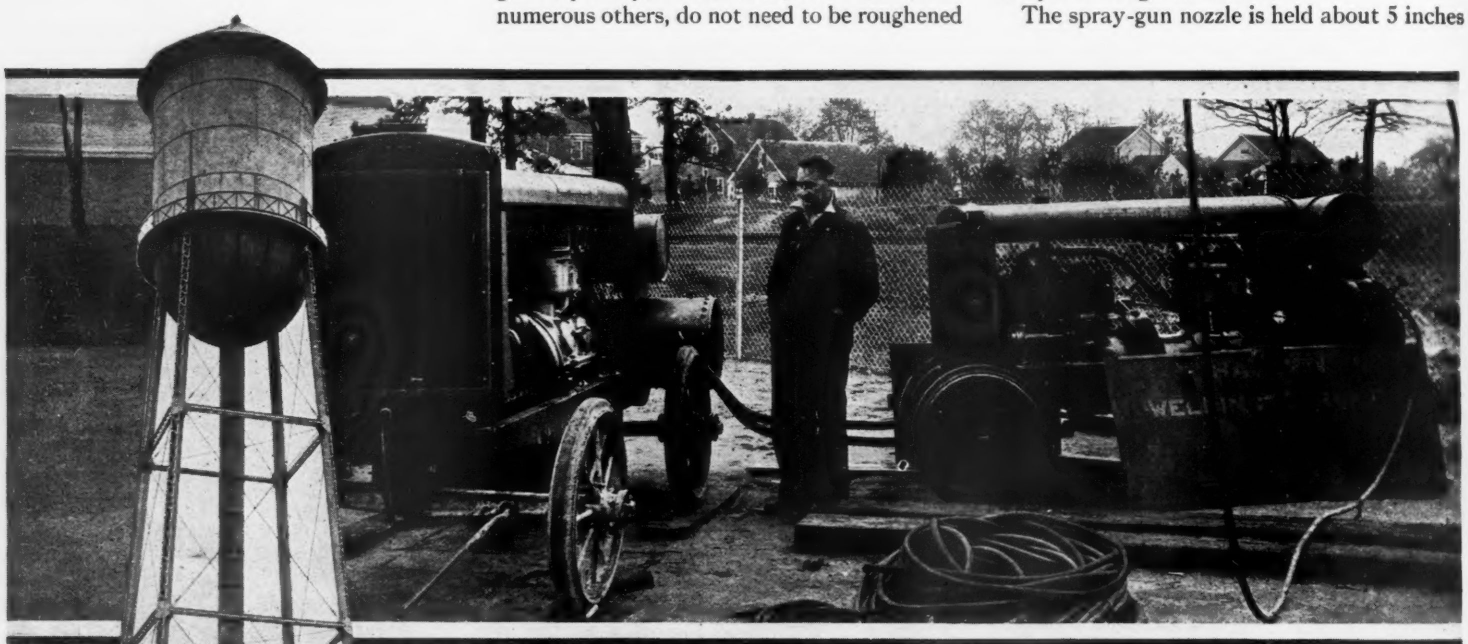
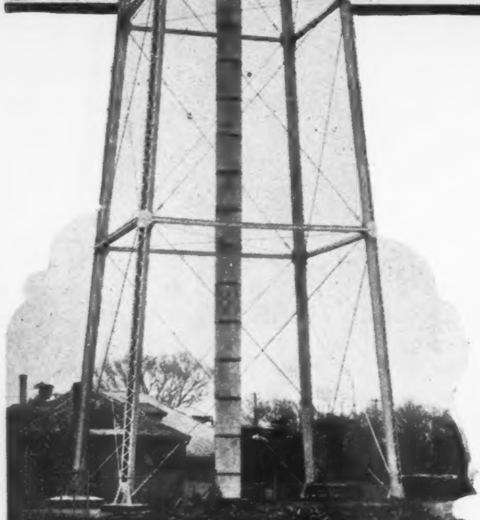
In many instances where metallic surfaces are metal coated so as to stay the effects of corrosion, paint or some other preparation might answer the same purpose but in lesser degree. In other words, the spraying of metal does a more permanent job. However, its cost is greater. On the whole, then, the question of the method to be used will be determined by measuring the effectiveness of the various available agencies against the financial outlays they require. Upon careful analysis of the different factors involved, a decision can be readily reached as to which method is economically the more feasible in a given case.

Compressed air serves three essential functions in the metal-coating process. The first, that of atomizing and spraying the molten metal, has been already mentioned. Its second use, when the materials to be coated are metallic, is that of preparing the surfaces to receive the spray. A perfectly smooth plate of steel or iron, for example, will not be conducive to setting up a tight bond between the original metal and the sprayed coating. It is necessary that the surface be slightly roughened, also that it be scrupulously clean. It so happens that both of these things can be accomplished best and at lowest cost by blasting the surface with sand or steel grit. This is a fortunate circumstance, inasmuch as it permits doing both operations with air from one source and reduces the amount of equipment required. Surfaces of such materials as unglazed pottery, brick, wood, terra cotta, and numerous others, do not need to be roughened before the application of the metal. With certain other classes of materials which have smooth surfaces, preheating serves to increase the strength of the union. This is true of glass, although it also is sometimes given a light blast with sand prior to being coated. The third application of compressed air is that of driving the small air turbine which feeds the wire.

Standard spray guns, with nozzles attached, weigh only about 4 pounds and can, accordingly, be easily handled. The wire is drawn from a reel or spool and is fed, at any desired speed, by a mechanism which is operated through gears from the air turbine—the small amount of compressed air required for this purpose being diverted through a separate channel. Oxygen and acetylene at pressures from 13 to 15 pounds are directed through ports arranged in such a manner that they form a cone-shaped flame. As the end of the wire is progressively fed into the apex of the cone, where the heat is greatest, the metal is instantly melted. It then enters a jet of compressed air, at a pressure of from 45 to 55 pounds, which serves to atomize it and to carry it through the nozzle.

The spray-gun nozzle is held about 5 inches from the surface being coated, and, at that distance, the molten spray covers a circular area about 2 inches in diameter. The metal particles issue from the nozzle at a speed equivalent to about 567 miles per hour, which is only a little below that of the muzzle velocity of a shotgun. Thus, the spraying apparatus is a gun in the true sense of the word. The spray is kept perpendicular to the surface being coated, and is moved back and forth in passes which apply a thickness of metal from one- to two-thousandths of an inch, depending upon the metal being sprayed. Any desired thickness can be deposited by repeating this procedure. When this is done, the second series of passes is preferably run at right angles to the first series and succeeding ones are alternated as to direction.

Most standard spray guns use wire ranging

PROTECTING A WATER TOWER

Hundreds of communities depend for their water distribution on elevated tanks similar to the one at Riverhead, N. Y., and which is pictured here. To stay corrosion, it has been customary to apply tar or some similar compound to their interiors and paint to their exteriors. Such protective coatings have to be renewed on an average every four years. In this instance, it was decided to sand blast the interior and to spray it with pure zinc. The cost was approximately double that of painting; but it is expected that the tank will require no further maintenance for from 25 to 30 years. There are 6,400 square feet of surface in the tank and in its 4-foot standpipe. Three coats of zinc were applied, amounting to about 3½ ounces to the square foot. The work was done by the Hallen Welding Company, of Long Island City, in conjunction with the Metallizing Company of America, Inc. Extension of the field of metal-spraying to work of this sort is made possible by portable air compressors.

from 20 to 10 Brown & Sharpe gauge—that is, from about three-hundredths to one-tenth inch in diameter. In some cases, diameters up to three-eighth inch have been employed, but reports from manufacturers of spraying equipment indicate that successful results can seldom be obtained with large sizes. In general, the controlling factor of the size of the wire and of the rate at which it is fed through the gun is the melting temperature of the metal being sprayed. However, even with metals of low melting temperatures, such as lead, there seems to be a limit to the diameter that will produce satisfactory, effective, and economical results. For example, it has been the experience of one manufacturer at least that about 50 per cent more lead can be deposited from a one-tenth inch wire than from a three-eighth inch wire.

In general, the speed of feeding ranges from about 10 feet per minute up to 35 feet or more. The weight of the wire varies from about 1¼ pounds an hour for iron to as much as 90 pounds for lead. Similarly, the area that can be coated to a thickness of six-thousandths of an inch, representing four successive applications, differs from about 6 square feet an hour for iron to 60 square feet for lead. It is possible to spray even tantalum, which has a melting temperature of 5,250°F., but the great bulk of the work is, of course, done with metals of moderate melting temperatures. Some of the ones that are most employed, aside from those already mentioned, are: ascoloy, brass, bronze, cadmium, copper, German silver, monel, nickel, high-carbon steel, manganese steel, stainless steel, and tin.

The use of metals having high melting points is largely limited to such applications as building up shafting and bearing surfaces and filling blowholes in castings. The reason for this is that the surfaces must be polished after the metals have been deposited, and this cannot always be done satisfactorily. For instance, while a shaft that has been coated with stainless steel can be readily polished, an attempt to use the same treatment on stainless steel that has been deposited on sheet metal will generate so much heat that the coating will tend to lift. Makers of spray equipment are therefore careful in their recommendations as to where to use the so-called "hard" metals.

Although the air requirement varies somewhat with the class of work and the type of apparatus, there is ordinarily needed about 100 cfm. at up to 100 pounds pressure for sand- or grit-blasting, and from 35 to 50 cfm. at 40 to 60 pounds pressure for spraying. As previously noted, both can be obtained from one compressor, the pressure for the spraying being controlled, as desired, by means of a reducing valve. To make sure that the surfaces will be coated before corrosion has an opportunity to start, it is the usual practice to spray ferrous materials within 24 hours after they are blasted. Where large surfaces are being treated, the coating usually follows the cleaning operation fairly closely, the crews being arranged accordingly.

Photomicrographs disclose that sprayed metal coatings consist of myriads of plastic particles which, owing to their high velocity,

Photo, Metallizing Company of America, Inc.

COATING INSIDE SURFACES

This tank is in the process of being coated with zinc preparatory to being mounted on a motor truck for the distribution of petroleum products. Note that the wire is fed to the spray gun from a reel, while the tank is mounted on rollers to facilitate turning it.

flatten out on the underlying surface and adhere to it firmly. As other particles are deposited they interlock with the first ones, forming a sheathing which may be roughly compared with fish scales. The finished surface, as sprayed, has a matte or sanded finish that can be scratch brushed, polished, ground, filed, or machined. The initial coat penetrates pores and minute openings in the surface, and subsequent ones build up the layer evenly. Proof of this is found in the fact that when parts such as shafts are being built up for remachining, it is necessary to allow only about .012 of extra metal in order to insure a perfectly true finish. The bond between the sprayed metal and the surface that is coated is a purely mechanical one: no welding or brazing effect is obtained. The density and hardness of the coating are determined largely by the fineness of the spray. Small particles not only fill minute voids in the surface more completely. but also join one another more tightly. It is therefore important that the correct size of wire be used and that the rate of feed, gas and air pressures, and operating technique all be carefully controlled.

As already stated, the predominant use of metal-spraying is for increasing resistance to corrosion, particularly of ferrous metals. It is now generally accepted that corrosion takes place at ordinary temperatures only in the

Photos on these two pages from
Air Reduction Sales Co.

TWO DIFFERING USES

Machine parts built up with metal can be chipped, filed, or otherwise worked just like the base material. At the left a workman is shown dressing a diaphragm for a steam turbine. Metal materials that are subjected to high temperatures for long periods are made more heat resistant by coating them with aluminum and then giving them a special treatment which is termed alumetizing. This increases durability as much as 100 times. Locomotive grate bars and arch tubes that have been given this protection are shown on the right.

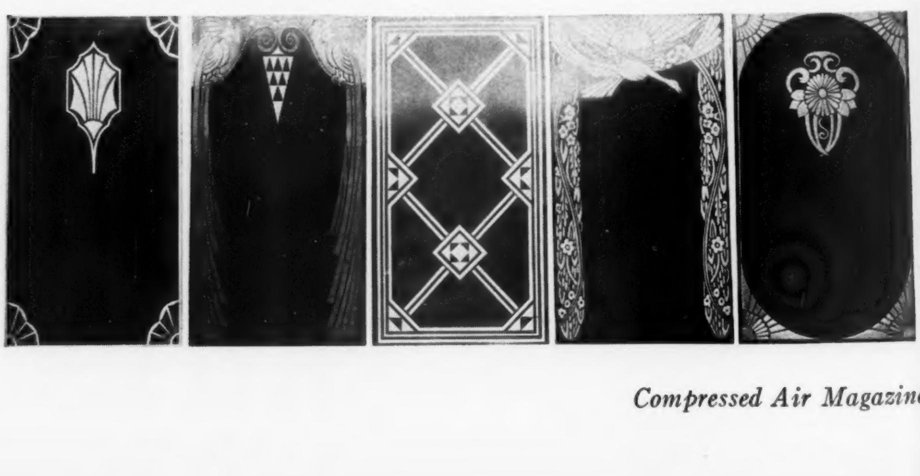
presence of moisture, and that it results from the interaction of hydrogen ions which are displaced from the water with the exposed surface. Positive electric charges in the hydrogen ions are transferred to the metal, which is said to become ionic. Similarly, when two dissimilar metals are brought together in the presence of an electrolyte, an electric current will flow from one to another. The direction of flow depends upon their respective electrical characteristics. These are known, and are the basis of what is called the electromotive series of metals. It so happens that the order of the metals in this series is the same as their order of chemical activity. Each metal is anodic, or electropositive, to those that follow it in the table, and is cathodic, or electronegative, to those that precede it.

The practical importance of this is that the current will flow from the anodic to the cathodic metal, thereby hastening or retarding corrosion according to the relative places in the electromotive series of the metals concerned. For example, aluminum or zinc, which are anodic to iron, will protect it from corrosion, but tin or copper, which are cathodic to iron, will accelerate its corrosion. Aside from these considerations, zinc, aluminum, and lead possess unusual properties for arresting corrosion, inasmuch as they do not themselves corrode progressively as does iron. Instead, corrosion gives rise to a tough, exterior layer of salts which practically stops further decomposition.

Even metals which are cathodic to iron are sometimes used as coatings because they have certain desirable properties. For example, lead and tin are highly resistant to certain acids and, as a result, are suitable for lining vessels or other containers in which those acids are to be put. It is important in such cases, however, that the coatings be made impervious, as they provide only mechanical protection, and any penetration of the exterior layer will have the effect of hastening the deterioration of the underlying ferrous metal. In like manner, copper, which is resistant to corrosion, forms a good mechanical sheathing for iron and steel so long as it remains intact and mosisture is kept from reaching the base metal. Brass, bronze, monel, nickel, and German silver are all cathodic to iron, but their special qualities sometimes result in their being chosen for coatings. Summed up, aluminum, zinc, and cadmium offer the most complete protection for iron and steel, and are, accordingly, preferable except where service conditions require some other metal.

It is impossible in an article of this length to discuss the many and varied uses of metal coatings or completely to cover the technique of applying them. It can be stated, however, that the process is being extended to virtually every industry. Recently there has been a particularly noticeable trend towards the employment of metal coatings on outdoor locations, as compared with operations which are conducted in shops set up for the purpose. All the necessary equipment, including compressors, can be had in portable types; and with the experience that has been gained, and the continual improvement in apparatus, the cost of applying coatings is being progressively reduced. Two examples of this growing use may be briefly mentioned. These are the coating of gas holders, oil tanks, etc., and of water tanks.

On the Pacific Coast, where corrosion is rapid because of the moist, saline atmosphere, the oil and gas industries are applying zinc and aluminum to many of their holders and making comparative studies which may lead to the general adoption of this method in preference to those heretofore used. Recently, surfaces of this kind aggregating 250,000 square feet of area were sprayed with zinc to a thickness of between .004 and .005 inch. Using two spray guns of different types, an average of 400 square feet was coated daily, and experiments with a third type of gun indicated that it might be possible to obtain even greater speed. The over-all cost of labor and materials, including sand-blasting, came to



LARGE AND SMALL

Where quantities of small pieces have to be handled they are coated in mass by the aid of a revolving barrel with the spray gun in a stationary position (right). The reverse procedure is used when treating large parts such as the 23-inch-diameter by 60-inch cast-iron roll for a paper-finishing mill shown on the left. The roll is caused to revolve while the three spray guns coat its surface evenly. In this case KA-2 metal, ⅛ inch thick, was applied to prevent corrosion. Fifty pounds of metal was applied in 45 hours.

approximately twenty cents per square foot.

One of the accompanying illustrations shows an elevated water tank, in a Long Island city, which was recently sprayed with three coats of pure zinc. Previously it had been necessary to apply tar and paint about every four years. Inasmuch as it was deemed advisable to sand blast the surface before renewing the protective covering, it was decided to try metal coating. The job was taken by a contractor for $1,200, which compared with an estimate of $700 for sand-blasting and painting. It is expected that the longer period of protection that the zinc will afford will more than offset the increased cost.

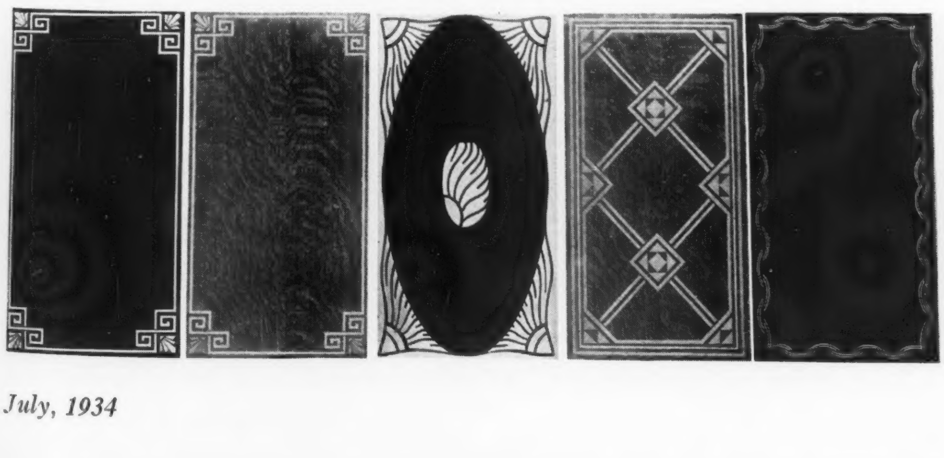
It will be apparent at once that the number of variables involved makes it impossible even to approximate the average cost of metal-coating. The nature of the work, the metal which is sprayed, and numerous other factors influence the outlay entailed. In general, extensive even surfaces can be coated less expensively than small, irregular ones. One reason is that the work can be conducted faster. Another is that on small pieces there is, unavoidably, considerable "edge loss" when metal is shot past the borders of the material instead of being lodged upon it.

Various special treatments make it possible to increase the effectiveness of metal-coating. For example, where it is desired to prevent deterioration resulting from exposure to heat, the object concerned is often given a treatment which is called alumetizing. This consists of spraying with aluminum, then of applying three coats of potassium silicate, and of heat-treating. This produces a ferro-aluminum alloy which penetrates the surface with a coating of aluminum oxide. This checks scaling from heat, and is claimed to increase durability of the parts as much as 100 times. Gas burners, grate bars, boiler baffles and tubes, and similar pieces are frequently so treated.

In addition to building up undersized or mismachined parts, as has been mentioned, metal-spraying often offers a means of salvaging castings which develop minor defects after considerable work has been done on them. Blowholes, pits, and other depressions may be filled inexpensively by this method. The strength of the casting is not impaired, and it will machine equally well after being sprayed.

Many beautiful effects may be obtained by spraying various metals on limestone, sheet metal, wood, pottery, or other materials. Sometimes objects are thereby rendered salable at increased prices. There is an actual case on record where vases, that would not sell even when reduced from $3 to 75 cents each, were readily disposed of at $18 each after the glaze had been sand blasted from them and metal been applied. Spandrels of clay coated with aluminum combine the beauty of metal with the durability of ceramics, and are coming into vogue for architectural decorative purposes. In similar manner, stone, brick, or concrete may be coated with any desired metal.

Foyers, lobbies, elevator interiors, and other parts of buildings are now frequently embellished with metallic patterns sprayed on various materials with the aid of stencils. Intricate designs are easily imparted to such surfaces, and it is possible even to make inlays. Under certain conditions of application the metal coatings may be removed so as to obtain a mold of a statue or of any other object to serve as a means of producing facsimiles of that object. Thus, in the arts, as in industry, metal-spraying is rapidly extending its scope of usefulness.



THE DECORATIVE SIDE

In addition to its manifold uses in industry, metal-spraying is coming into vogue for decorative purposes. The pictures at the left illustrate patterns sprayed on steel panels by the use of stencils. The temperature rise is so slight that wood, fabrics, and even thin paper can be metal coated. In some cases, fine laces serve as stencils to obtain delicate patterns.

Firewood from Sawmill Waste

J. K. NOVINS

WARMTH THAT COMES IN A BOX

This new form of firewood is clean, free from splinters, and convenient to handle. Small pieces can be chipped from the logs for kindling fires or where only a small blaze is desired. Since the density of the compressed product is 3½ times that of wood, fires do not have to be replenished so often.

MODERN packaging has revolutionized the retail distribution of foodstuffs and other consumer goods. Now it is to lend a hand in the large-scale distribution of fuel made of waste materials.

Who would have believed two or three years ago that sawdust would ever appear in American homes in the guise of wood put up in attractive cartons for convenient handling? And who would have thought that sawdust would ever be found on grocery-store shelves as a competitor of coal and other fuels for home consumption? That is just what has happened; and the material that was formerly dumped on the refuse pile—with the exception of a very small percentage that was burned in furnaces at the mills—is now being put to profitable use.

Almost over night a new industry has sprung up—the production of Pres-to-logs, as the new fuel has been named. Powerful machines have been developed that convert the loose by-product of the sawmill into compact logs, 12½ inches long and 4 inches in diameter, that have about 3½ times the density of natural wood. The finished logs weigh 8 pounds apiece, and are packed in cardboard containers ready for delivery.

In the Pacific Northwest, where the industry originated, chain groceries, and of late also department and stationery stores, have been selling this new fuel to housewives for furnaces, kitchen stoves, fireplaces, and heaters, and even for camp and picnic use. Recently, a consignment of Pres-to-logs was sent to northern California as the first step in the nationwide distribution of the product.

One of the interesting features of the industry is that the sawdust and other wood waste is transformed at the source of supply—the necessary equipment being transported to the mill as a unit to take up production at the peak of the season. The machinery was developed by engineers of the Weyerhaeuser Timber Company; and is being manufactured by Wood Briquettes, Inc., of Lewiston, Idaho, a Weyerhaeuser subsidiary, and leased to mills operating under exclusive Pres-to-logs marketing rights in certain areas. Where several small plants with limited output are located in the same general neighborhood, one centrally disposed press may be sufficient to serve them all.

In the new Weyerhaeuser Timber Company plant at Longview, Wash., six Pres-to-logs machines have been installed. Each is housed in a separate building, and has a capacity of 10 tons in a 24-hour working day. The equip-

ment includes a chain conveyor that carries the finished fuel to the car-loading platform. It is planned to increase the plant's output by adding ten more presses. At Lewiston, at the mills of the Potlatch Forests, Inc., there are five machines in use at the present time. These have a combined capacity of 50 tons daily.

The machines required for the work are big affairs and weigh 10 tons each. They operate on the pressing-screw principle—that is, a large tapered screw with its compressing head feeds and presses the raw material in two successive stages. Next the compacted sawdust goes into a series of dies in a rotating disk that brings each die in position for filling. After the disk has made a complete turn, the screw again brings pressure to bear on the material in each die in turn, this time forcing it out as a finished log.

The disk is a strong steel casting and is so arranged that its dies can be cooled by circulating water. This is essential, as the friction set up during the manufacturing processes raises the temperature of the wood in the making to as high as 450°F. The dies are of chromium-steel to resist abrasion and corrosion. The third operating part of the machine is the pressure-regulating cylinder which controls the density of the logs and makes it possible to turn out a uniform product.

The work, as can be appreciated, necessitates machinery of sturdy construction. The screw and compressing head, which develop a maximum pressure of 200,000 pounds, deliver a pressure of 20,000 pounds per square inch against the sawdust when the screw is fully extended, while a pressure of from 30,000 to 40,000 pounds is required to rotate the disk. The maximum pressure applied by the pressure-regulating cylinder is 25,000 pounds.

The material utilized consists of clean sawdust and shavings, which are ground in a hammer mill and then forced through pneumatic pipe conveyors to the presses which automatically turn out logs of a size that has been found to be most suitable for general use as well as for packaging.

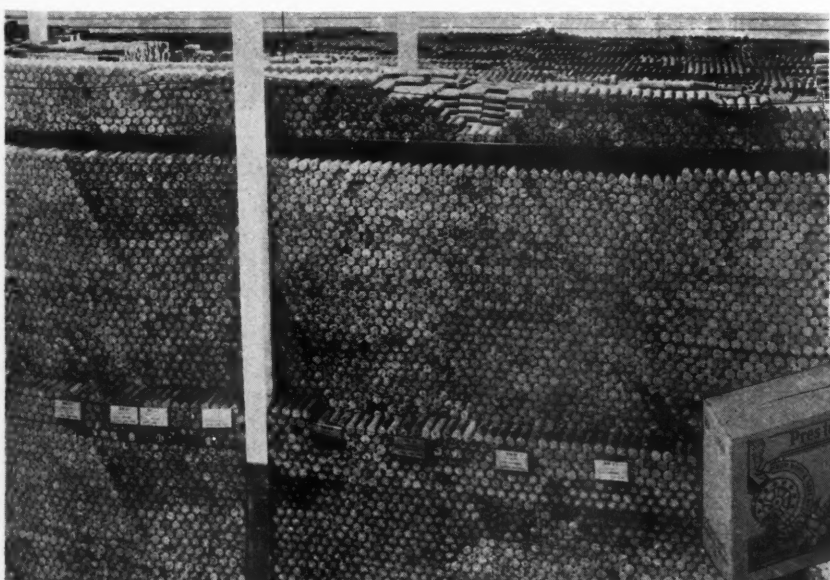
WHERE LOGS ARE COMPRESSED

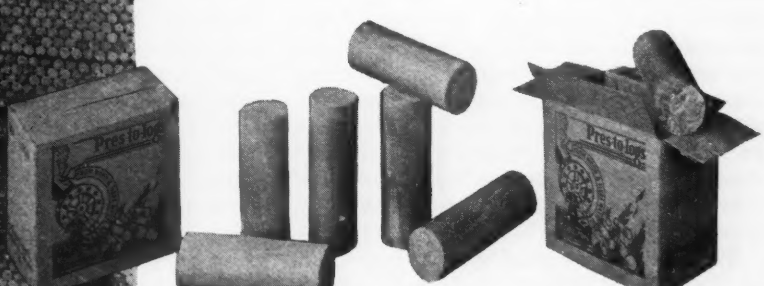
A row of machines in a lumber mill of the Northwest in which finely divided wood particles are pressed into household fuel. Pressure alone is relied upon, no binder being added. The finished logs are shown traveling down a conveyor at the right-hand side.

Aside from their cost, which is said to be lower than that of other household fuels, Pres-to-logs are claimed to have numerous other advantages. The wood burns with a high flame free from smoke, produces intense heat, and leaves a residue of but three-tenths of one per cent of ash. Because of its cleanliness and the ease with which it can be purchased in small quantities, this fuel should appeal to city dwellers who enjoy the blaze of an open fire. It is reported that one log will burn for three hours in a fireplace without sparking. Cut up into slices it serves as kindling or can be burned in kitchen ranges—a third of a log chopped into 3-inch pieces being sufficient to cook an average meal. When in bulk, one ton can be stacked in 35 cubic feet of space.

With unlimited supplies of the raw material available at sawmills, it is not surprising that many of them are planning to put it to profitable use in this manner. Formerly, only a small percentage of the lumber produced was finished or surfaced at the mills: today most of it is shipped to consumers in that way. This has added enormously to the piles of sawdust, shavings, and hogged chips at every sawmill. Until Pres-to-logs appeared, the disposal of this waste represented a real problem.

Sugar-cane refuse, wheat straw, and other fibrous waste products of the farm and forest are potential raw materials for machinery of the type developed by the Weyerhaeuser Timber Company, and may, like sawdust, be transformed into commercially practicable fuels. Thus, it is possible that the industry now so well established in our Northwest may become one of world-wide importance.

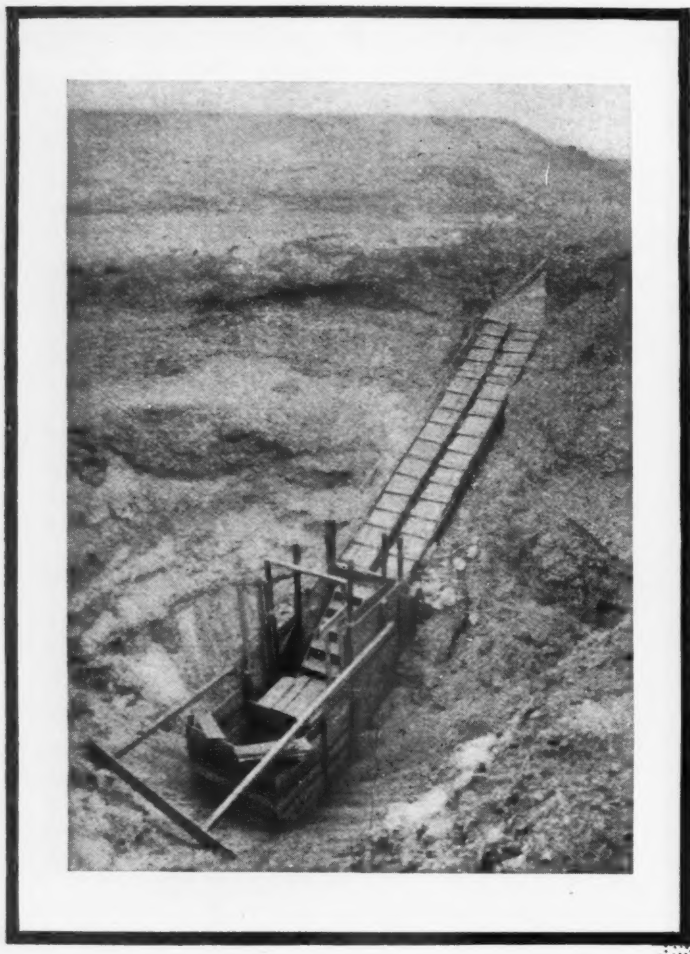


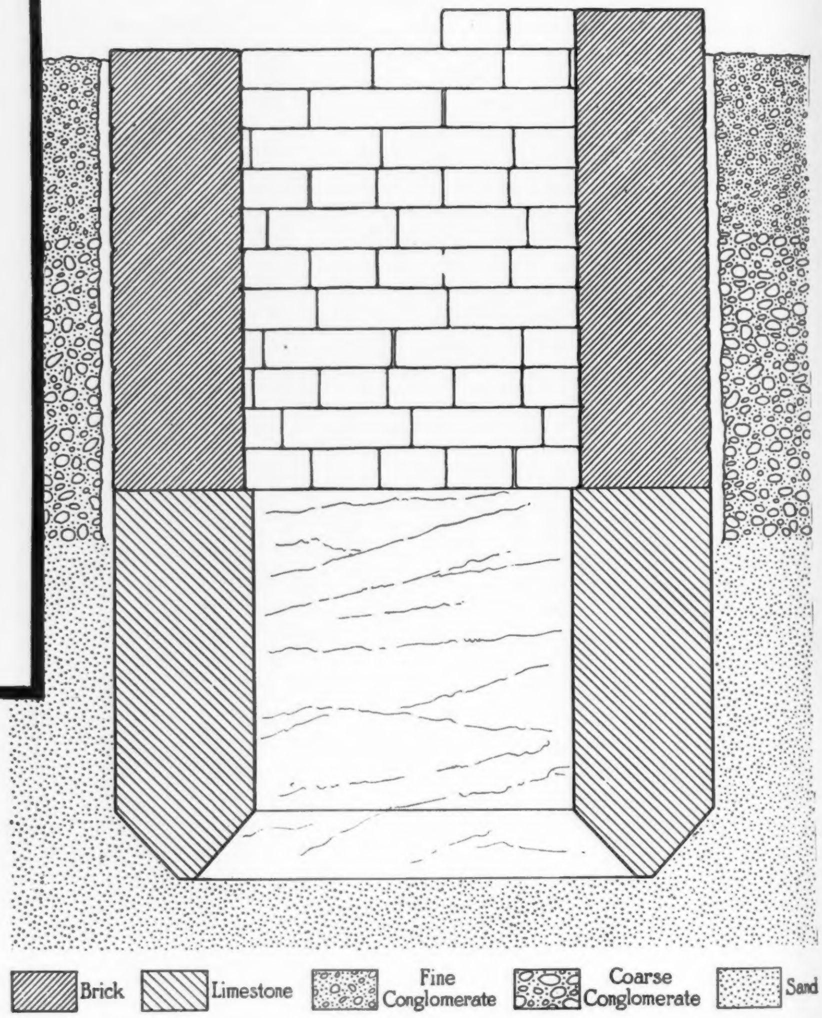


WASTE MADE USEFUL

This huge stack of firewood had its genesis in hitherto worthless sawdust. It represents a portion of the storage pile in a Pacific Coast mill. These compounded logs are packed six in a carton, weighing about 48 pounds, and are merchandised through groceries and other family supply stores.

Caisson Work of Forty Centuries Ago





BUILT FROM THE TOP DOWN

One of the pits leading to a tomb and after it had been opened up by the archaeologists of the Egyptian Expedition conducted under the auspices of the Metropolitan Museum of Art. To accomplish this in the unstable ground, they resorted to the same methods that were used when the shaft was originally sunk more than 4,000 years ago. At the left is a diagrammatic sketch of the stone caissons built by the ancient Egyptians in sinking the pits and excavating the burial chambers for Se'n-Wosret I and his family.

LAST year, brief editorial mention was made in COMPRESSED AIR MAGAZINE of the fact that shaft-sinking by the caisson method is of ancient origin, that it was practiced by the Egyptians as far back as the twentieth century, B. C., when they built the pyramids and tombs of Se'n-Wosret I and of his royal household.

This interesting discovery was made by the Egyptian Expedition of the Metropolitan Museum of Art, of New York City, during its 1931-32 explorations at Lisht, about 40 miles from Cairo. Since then a report of the season's work has been published by the museum, and in it Ambrose Lansing, a member of the expedition, gives the following detailed account of one of three such caissons uncovered at that time and how, by means of them, the pits or shafts leading to the burial chambers were in all likelihood sunk. To quote Mr. Lansing:

"While the heavy clearing of the inner court on the west side of the pyramid was going on, smaller gangs of men were at work clearing the outer court on that side. At one point toward the northwest corner of this court we had found in 1924 a tomb in the form of a brick vault sunk just below the surface of the ground, and we had supposed that the absence of pits in the area we had cleared was due to the peculiar nature of the ground. The upper strata consist of firmly packed red sand overlying a coarse conglomerate. Below this in the rest of the site lies soft limestone which is a very good medium for the cutting of tomb chambers. In the area in question, however, there exists a deep pocket of coarse white sand having scarcely any cohesive quality. It is impossible to dig an open pit here without sand running in from all sides, undermining the hard upper stratum and causing its eventual collapse.

"Although we failed at first to find any pits, it is fortunate that we did not give up clearing this part of the court. Had we done so we might have missed what was, from the archaeological point of view at least, quite the most interesting discovery of the season. In the course of our clearing we came upon a depression in the court which extended through the upper stratum into the sand level. The fill was not clean, and we continued to remove it until we came upon brick walls forming an irregular rectangle. By building a rough wall on this we succeeded in blocking the flow of the sand and were able to clear the space between the walls. As we went down they became more regular and showed themselves to be the typical brick lining of the mouth of a pit; but they extended to an unprecedented depth, and we could not make out how it had been possible to build them up through a layer of nearly seven meters of loose sand. The explanation came when we got to the bottom of the walls. We found that they had been built from the top down instead of from the bottom up, incredible as this may seem.

"There must have been a master mind among the engineers engaged in the building

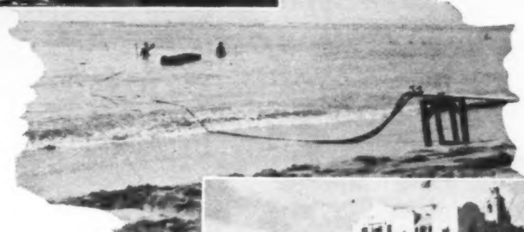
of the pyramid. A problem was solved then by an invention which is still in use and which has made possible many of the huge erections of the present day—the caisson. Of course the principle may have been used before this period, but this application of it, so far as we know, is the earliest yet discovered.

"The old Egyptians set about their task somewhat in the following manner. Having determined the place and the size of the pit, they cut through the hard upper stratum to the sand level, making the cutting sufficiently large to allow for a brick lining to the pit. A block of limestone was then cut to the same dimensions as the pit and to an appropriate height. This was pierced with a vertical hole and hollowed out to the size which the intended shaft would have after the brick lining was laid up. The hollow block was then lowered into the pit until it rested on the sand. On the rim of the caisson was built a brick wall of the same thickness as its top surface, with smooth faces both on the inner and on the outer side, the latter being, practically speaking, against the cut in the rock. When this wall had been constructed to the level of the ground, or perhaps a little higher, the digging of the pit was recommenced. As each basketful of sand was removed, the stone caisson, and with it the brick wall which rested on it, settled slightly. The sand had to be removed with care from under all four sides equally, in order to prevent the stone from tilting. Gradually the stone sank through the sand, and as it sank courses of brickwork were added to the wall above. Eventually the hollow block rested on the limestone which formed the bedrock below the sand stratum, and the brick walls extended from it to the surface of the ground. From this point on all was plain sailing. The pit was cut on down through the limestone with the same length and breadth as the hole in the caisson stone until the desired depth had been reached.

"What previous experience and experimentation had been necessary before this feat was accomplished so successfully it is impossible now to know. The bottom side of the stone had been beveled nearly to an edge, a refinement which indicates that difficulty had been encountered in causing a flat-bottomed caisson stone to sink through the sand. In an earlier attempt the pressure of the sand must have pushed in the brick walls, for that possibility had been guarded against in the caisson under discussion. Traces were left of a rectangular socket at each of the four corners of the caisson stone, the upper part of the hole through the stone having been left roughly circular instead of square, as it was below, in order to allow for these sockets. Into them beams of wood must have been set, extending upward and forming the support for planking, against which the walls were built and which helped to resist the pressure of the sand.

"The beveling of the bottom of the caisson stone caused us difficulties. The first layer of limestone on which the stone rested was of a soft shaly consistency, and the pressure of the edge of the caisson on it resulted in its breaking away at some later period. The sand rushed in to such an extent when we got to this level that we had to stop working. We took a leaf from the Egyptians' book by making a caisson of wood, slipping it through the hole in the caisson stone, and driving it down below the level of the stone. When we found by sounding through the sand that the rock in all directions was intact we drove sharp-edged boards horizontally into the soft limestone and stopped the flow in this way.

"This tomb had been plundered and so, alas, had one similarly dug and of larger proportions. In the latter case the brick walls were intact at the upper end of the pit near the surface but had been crushed in at the lower end, although the mass of mud held together fairly well. At a certain depth, however, digging became dangerous, and we had to resort again to a wooden caisson. We fully expected to find another stone caisson at the bottom of the brick walls and were somewhat nonplussed to find them resting, albeit irregularly, on the rock-cut part of the shaft. Traces of decayed wood gave away the secret. The caisson had been made of wood and had rotted away in the damp ground. The pit went on down to a depth of nearly twenty meters, ending in a passage opening eastward very near the level of the subsoil water."



Removing Submerged Coral with Air Tools

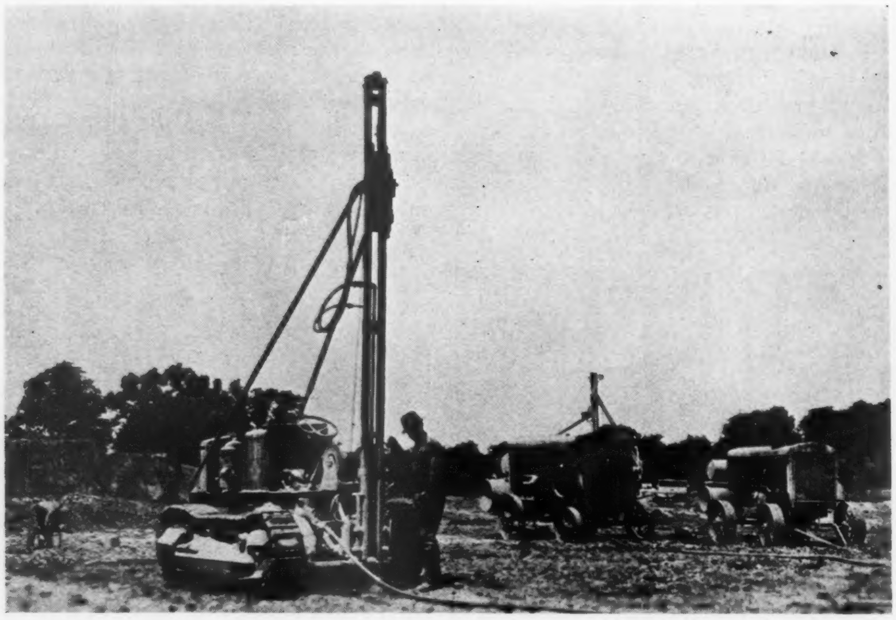
COMPRESSED-AIR equipment is used in all sorts of odd situations, on occasions even underwater. The accompanying pictures illustrate an unusual application of pavement breakers at Waikiki Beach, Honolulu, where they are being employed in the removal of projecting coral.

A coral formation underlies this famous beach, and from time to time the shifting of sand induced by wave action exposes some of it. The sharp edges of the rock are so menacing to human feet as to oblige bathers to shun the affected area. Until recently no effort was made to remove it, as no effective way of doing this presented itself. Under the circumstances, the usual procedure was to erect jetties to direct the ocean currents in such a manner as to deposit a new covering of sand over the coral. A few months ago a private-property owner succeeded in cleaning up the beach in front of his home with air-driven tools, and since then this method has been generally adopted for similar work.

The operations illustrated are being conducted over an area of about 5,000 square yards comprising a strip of beach running in front of the Moana Hotel and the Outrigger Canoe Club. The work is classed as a CWA project, and is being financed by the Federal Government. About fifteen men are employed, mostly Hawaiians and a few Filipinos. When on the job they wear water goggles such as are ordinarily used by native fishermen.

As the pictures show, the necessary air is furnished by a portable compressor stationed near the water's edge, and lengths of delivery hose are run to the points of application. A barge is anchored at the scene of operations, and as pieces of coral are broken off the men pick them out of the water and load them into this craft. The coral is later taken ashore for disposal. Work is carried on six hours a day. It began February 1, and since that time removal has proceeded at an average rate of 8 to 10 cubic yards of coral a day, or approximately 200 cubic yards a month.

Tractor-Mounted Drill Speeds Reservoir Excavation



FAST DRILLING SET-UP

To increase the mobility of a wagon drill, an Illinois contractor mounted it on a tractor, as shown in these pictures. This enabled one man to move and to operate the drill and speeded up the over-all performance.

BY MOUNTING a wagon drill on a tractor, H. H. Enbody & Son, contractors of Aurora, Ill., were enabled to make remarkable progress on an excavation job at Springfield, Ill. Using this equipment, one man drilled a total of 40,000 cubic yards of rock. An average of 59.6 linear feet of hole was drilled per hour.

The work was done in connection with the building of a dam to form a reservoir for the City of Springfield. The general contractor, C. E. Carson Company, awarded a subcontract to H. H. Enbody & Son for the excavation of all rock and dirt. The surface material was stripped away exposing bedded shales and sandstones, which had to be drilled and blasted.

The nature of the operations called for a large number of vertical holes, and an X-71 wagon drill was selected as being most suitable for the purpose. To increase the mobility of the unit, the idea of mounting it on a tractor was conceived, and this was done in the manner illustrated. This made it possible for the drill operator to move the drill unaided and to reduce to a minimum the time required for shifting it from hole to hole. The latter provision was an important consideration in increasing the over-all efficiency, for, as the rock drilled easily, moves to new locations had to be made frequently.

Using air at 55 to 60 pounds pressure at the drill, as much as 730 feet of hole, consisting of 73 ten-foot holes, was made in a 10-hour shift. The air was delivered from a portable compressor through approximately 100 feet of 1½-inch hose. Later, with two compressors supplying air and maintaining a higher pressure, the 10-hour production rose to as high as 900 feet of hole. The contractors estimated that this drill maintained a production that would have required the use of five or six "Jackhamers."

NEW MIRROR OUTSHINES FAMILIAR LOOKING-GLASS

MOTION-PICTURE producers are counting on saving much electricity through the use of a new mirror or reflector that has been developed by Dr. H. W. Edwards, physicist at the University of California. It is known as the "pancro" mirror because it reflects all colors alike; and, besides, it is approximately 93 per cent efficient. Ordinary silver mirrors, on the other hand, have varying powers of reflection. With red light the efficiency is about the same for both, but in the case of violet light the silver mirror is capable of reflecting but 81 per cent. These figures are even less when the glass is interposed between the light and the reflecting medium.

Looking-glasses, as we know them, are usually backed with silver or mercury. Dr. Edwards's reflector is faced with an alloy of aluminum that is deposited on the glass in an ingenious manner. The glass and a proportionate piece of the alloy are placed in an airtight chamber in which is induced a high vacuum. In this extremely rarified air the metal is heated to a high temperature and evaporates rapidly. The resultant metallic vapors condense on the cool surface of the glass and form a mirror of great brilliance that is exceptionally resistant to deterioration, does not tarnish, and, what is still more important, is free from the usual glass refraction and absorption and will, on that account, give properly colored and realistic images.

The Lick Observatory reflector, which is 36 inches in diameter, has been coated by this so-called vapor-plating process. Pure aluminum was used in this case, and was applied by Dr. J. Strong of the California Institute of Technology. A much larger aluminum-faced mirror is now in course of preparation for the giant telescope for the City of Pasadena. This reflector is to have a diameter of about 16.5 feet. In these and other instruments, mirrors of this type will undoubtedly find a large field of usefulness.

From a commercial standpoint, the moving-picture producer will, apparently, reap very substantial benefits. Enormous quantities of electricity are required in lighting the studios —in fact, as much as 45,000 amperes at 110 volts, enough to light a fair-sized community, may be consumed in photographing a single scene. Reflectors are needed in this work, because it would not be expedient to expose the actors to the direct glare of a battery of big electric lamps. Mirrors with increased powers of reflection, especially of blue and violet light so essential to photography, should therefore prove of value to the industry. Some studios are already equipped with them; and the expectation is that the reflectors will cut in half the amount of current now used for purposes of illumination.

EDITORIAL

A NOTABLE RECORD

ON June 2, the two-millionth cubic yard of concrete was placed in Boulder Dam with no formality other than the taking of a few photographs. It is no longer news to set down the fact that Six Companies Inc. are breaking all existing records for construction work of this type. They have been doing it so consistently that it is taken for granted that they will continue the pace or even accelerate it. However, the real import of what they have done and are doing can be emphasized by reciting a few facts.

According to the original construction progress chart, issued by the Bureau of Reclamation when bids were called for early in 1931, the placing of mass concrete was to begin on December 1 of that year and continue until August, 1937. Under this tentative program, the two-millionth yard was scheduled to be poured in August, 1936. It is apparent, then, that the contractors are some 26 months ahead of the projected time-table, having gained that much in a little more than three years.

The first concrete was deposited in the dam proper on June 6, 1933. Two hundred and thirteen days later, on January 7, 1934, a million yards had been placed. This was incredibly fast work. Yet, with forces better organized and fewer impeding factors, the second million yards went into the forms in 147 days. The average daily placement for the 2,000,000 cubic yards was 5,555 cubic yards: for the second million it was 6,800. All told, the 8-cubic-yard buckets had swung down from the cableways a quarter of a million times, an average of about 700 times a day. Nearly 4 cubic yards of concrete had gone into place every minute!

If the present rate of progress is maintained, the barrier will be completed in a total elapsed time of less than twenty months, or around April 1 of next year. However, since certain other phases of the undertaking cannot be speeded up in the same measure, actual use of the dam for power generation will begin at about the time originally set.

DAVE MOFFAT'S DREAM

THE discovery of gold in the bed of Cherry Creek near its confluence with the Platte River gave rise, in 1859, to a cluster of tents from which has grown Denver, Metropolis of the Rockies. A year after its founding, Dave Moffat, a New York boy of 21, reached there, intent upon making a fortune. Where thousands failed, he succeeded. First through mining, and later through railroading and banking, he amassed millions.

Through those busy years he was dreaming. He visioned a railroad cutting straight westward from Denver to the Pacific Coast, disregardful of the lofty mountains that lay in its path. The Union Pacific tracks skirted to the north, the Santa Fe to the south, following easier grades. The serpentine Denver & Rio Grande crossed the Continental Divide at Leadville, almost due west of Denver, but first ran south 125 miles to Pueblo to find a readily negotiable route along the Arkansas River. So far as transcontinental traffic was concerned, Denver was on a side track. Moffat's dream was to put it on a main line; and he knew that it would never attain full municipal stature until this was done.

So at 60 Dave Moffat began his real life work. He started to build the railroad of which he had long dreamed. The physical obstacles were herculean, but they were as nothing compared with the more intangible difficulties. It takes money to lay rails over a pass 11,660 feet above sea level. Capitalists in the East to whom Moffat appealed didn't share his enthusiasm, especially as his scheme might affect the earning power of the existing lines in which they or their friends were interested.

Undeterred by these setbacks, Moffat poured his private fortune into the work, and the rails crept upward and over the Divide. When he ran out of money, local people came to his aid to the extent of their means. The railroad got as far as Craig, in Moffat County, in the northwest corner of Colorado. Its objective was Salt Lake City. Considering Moffat's indomitable courage, it might have got there had he lived. But in 1911 he died. When the end came he was in New York trying, at 72, to raise money to carry on.

Moffat had planned a tunnel through the upper shoulders of the Divide, but to expedite matters he laid this idea aside for the time being and pushed on over the top. Eleven years after his death the people of Colorado took up his battle. They formed an improvement district and voted bonds for the 6-mile tunnel which would eliminate many miles of 4 per cent grade and greatly reduce the operating and maintenance charges. The tunnel was built, although it cost $18,000,000 as against the original estimate of $6,200,000.

Meanwhile the railroad, with no western outlet, lost money. It went into receivership, and probably would have ceased functioning entirely had it not been for such courageous individuals as the directing executive, W. R. Freeman, and a handful of others who managed somehow to cut corners on expenses and to keep it going. All this while the road touched the Colorado River at Orestod, only 42 miles from Dotsero, where the Denver & Rio Grande tracks came down the western slope from Leadville. They could be joined comparatively easily by a water-grade link, an insignificant construction job as compared with what had already been done.

Again, it was not physical barriers that blocked the way. It was the difficulty of surmounting conflicting interests. Finally the way was cleared, and two years ago the Denver & Rio Grande began building the Dotsero cut-off. On June 16 it was opened, with the Burlington's new streamlined *Zephyr* heading the inaugural procession.

Dave Moffat's dream has come true at last, though the years have warped it somewhat. At least, the goal he sought has been accomplished. Denver is 175 miles nearer the Pacific Coast than before, and the running time has been reduced by many hours. Between San Francisco and Denver, trains will run over the Western Pacific and Denver & Rio Grande Western systems. Eastward of Denver, the connecting line will be the Burlington, which operates over the shortest tracks from that city to Chicago.

SAFETY ON RAILROADS

LAST year our railroads piled up the best safety record in their history, a remarkable achievement in view of the fact that the depression is commonly credited with having depleted both equipment and personnel. Only 530 fatalities occurred among passengers and employees, as compared with 2,164 deaths in 1923. The number of injured was 17,555, only about 11 per cent of the 1923 total. Collisions and derailments totaled 4,586 last year, as against 24,000 a decade before. These figures are important from both humanitarian and economic standpoints. Safety pays dividends in two ways: it reduces property and liability costs, and builds confidence which increases patronage.

For the fifth time the Union Pacific system has made the best safety record among the Class A railroads. It operated 256,897,000 passenger-miles without injuring a passenger and with only two accidental deaths of employees.

Safety is now the paramount consideration of the rail carriers. More and more the human element is being eliminated and foolproof mechanical safeguards are set to watch over the welfare of those who ride on rails. Closer attention to roadbeds and tracks is one of the developments of recent years, and in these fields modern compressed-air equipment is playing an important part.

With highways growing more crowded and dangerous, the traveling public cannot help but be influenced by what the railroads are doing to minimize danger. The words "safety, comfort, and speed" express a policy which, if practiced religiously, should win back to the rail carriers a considerable volume of their lost traffic. It is pleasing to note that this basic transportation agency is seriously and actively striving to put such a policy into effect.

Industrial Notes

Germany's newest way of waterproofing concrete is to give it a thin coat of metal applied by means of the spray gun.

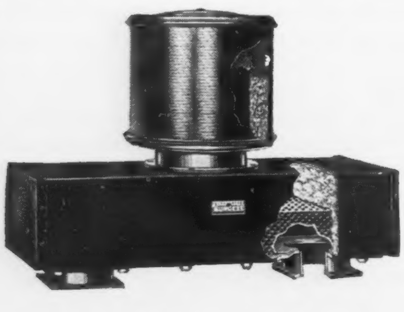
Window glass that lets in the sunshine and shuts out 70 per cent of the heat is said to be the newest product developed at the Corning Glass Works.

Groups of businessmen in different offices and even in different cities can now discuss matters over the wire and thus save the time incident to getting together. By what is called the Conference Telephone Service it is possible to talk from one instrument to three others on the same switchboard or to as many as nine phones located anywhere. The calls are handled by a special or conference operator; and a loud speaker permits those not talking to hear what is being said.

Putty containing rubber has been put on the market by The B. F. Goodrich Rubber Company, Akron, Ohio. It is called Plastikon, and while it has the appearance and consistency of ordinary painter's putty it is claimed to have virtues that the latter lacks. It requires no mixing, as it is practically free from oil; effectively resists corrosive chemicals and fumes; offers high resistance to moisture; and has a high degree of adherence to steel surfaces.

AIR CLEANER AND SILENCER IN ONE

A COMBINATION air filter and intake-air silencer for compressors as well as for internal-combustion engines for automotive and industrial use has been put on the market by the Burgess Battery Company of Madison, Wis. It is a compact piece of equipment that is said to deliver the air drawn through it free of dust and without the accompaniment of noise. The cleaner is mounted on top of the



silencer and is of a fairly new type in which the filtering medium consists of oil-saturated cellulose fiber. The oil held by the fiber feeds out because of the capillary action of the dust and grit as it accumulates, thus maintaining operating efficiency. The silencer is built on the same principle as the Burgess straight-through automobile muffler. A porous material is used to deaden the sound, and numerous perforations permit the unobstructed flow of the intake air.

Approximately 1,200 tons of steel plate, ¼ inch thick, is being used to face the upstream side of the El Vado Dam under construction in New Mexico by the Middle Rio Grande Conservancy District. The dam is of the gravel-fill type. It will be 170 feet high above the stream bed and have a length at the crest of 1,200 feet. The metal diaphragm is designed to protect the structure against percolation and wave action.

Ingersoll-Rand Company, 11 Broadway, New York City, has just issued a new 31-page bulletin, No. 12107, on its "Utility" air hoists. The publication is profusely illustrated, and describes both the single-drum hoist—which is used for handling materials of all kinds, moving timbers, spotting cars, etc.—and the double-drum hoist which is employed for slushing and scrapping, loading cars, dragline excavating, etc. A copy of this bulletin may be obtained from the company's main office or any of its branch offices.

Steel stacks that are exposed to the extremely hot exhaust gases from internal-combustion or diesel engines, and therefore to rapid deterioration, can be protected therefrom by coating their inner surfaces with molten aluminum by means of the metal spray gun. A steel company that operates several large gas-engine-driven compressors to supply air for its blast furnaces has tried it and, as a consequence, has safeguarded every stack in the same way. The original stack was still in good condition after two years of exposure.

Molds for making castings are commonly baked to give them the necessary stiffness. This process can be eliminated, we are told, by the use of a recently invented celluloid that is dissolved in acetone, butenol, or other suitable solvent to form a paste. The latter has a slight tendency to flow, but can be handled with a paddle, and is added in the proportion of 10 to 25 per cent of paste to 90 to 75 per cent of sand. This admixture serves as a facing only, the remainder of the mold being made of green sand. The celluloid also can be turned into a solution that is sufficiently fluid to permit spraying it on the face of the ordinary type of mold.

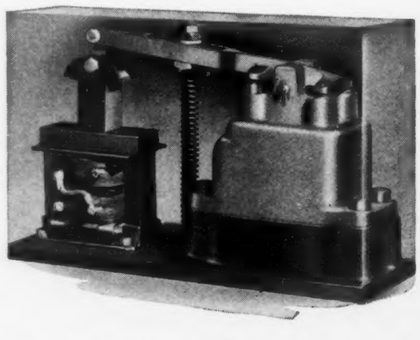
An important merger of interest to road-builders and to the construction field generally has been announced by Austin Manufacturing Company of Chicago and Harvey, Ill., and by Western Wheeled Scraper Company of Aurora, Ill., two old and well-established manufacturers of earth-moving machinery in the United States. Their consolidation became effective on July 1, and the new company is operating under the name of Western-Austin Manufacturing Company. The general offices of the corporation and of the Austin-Western Road Machinery Company is located at Aurora, Ill. The latter was formed to market the machinery manufactured by the aforementioned companies, and will continue to handle the sales of the Western-Austin Manufacturing Company.

How to Select Insulated Cable is the title of a new 80-page reference book published by General Electric Company, Schenectady, N. Y. It covers the more usual applications of cable for the transmission and distribution of electric power at normal frequencies, and presents in convenient form the information that is required in determining the kind best adapted for a particular installation. Several pages are devoted to methods of selecting conductor size; it describes the various types of insulation and finish; and gives tables of wire gauges and dimensions, as well as a bibliography for those that wish to know more about any particular subject relating to electric cable. The book, designated GEA-1837, should prove of value to electrical engineers, consulting engineers, architects, contractors, and others, and may be obtained from General Electric Company.

REMOTE-CONTROL AIR VALVE

A NEW type of electric or remote-control air valve has been produced by the Ross Operating Valve Company. It is available for use with either direct or alternating current and for operating both single- and double-acting pneumatic equipment. Special designs to meet individual applications can be provided.

Movement of the valve in one or the other direction is effected by pressing a push button. This energizes or deënergizes a solenoid that actuates the valve through the agency of an interposed connecting arm and spring. Either way, the spring cushions the valve. All operating parts are inclosed against interference or damage.



Ross solenoid-controlled valves, so it is claimed, make it possible permanently to install all piping and permit the removal of either the valve or the solenoid for replacement without delay. When installed immediately adjacent to the cylinders they are to serve they promptly deliver line air to the point of use, thus cutting down the air consumption and assuring quick movement on the part of the piston, or increased production.